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UDOT CONNECTING COMMUNITIES

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16. Abstract

This manual documents the Research and Development Program at the Utah Department of Transportation (UDOT). It describes the policies and procedures driving the program, the division's organization and staffing, how the customers and stakeholders are supported, and how the program interfaces with the strategic goals of the Department.

The manual describes the processes used to select and conduct research projects, how the Annual Work Program is prepared, and discusses the major funding sources supporting the program. It outlines the Development Program including the Technology Transfer, Experimental Features, New Products Evaluation, Implementation, and Library Sciences initiatives.

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Table of Contents

SECTION 1.0- INTRODUCTION 9
1.1 Purpose of the Research Manual 9
1.2 Authority of the Research Program 9
1.3 Overview of the Research Division 10
1.3.1 Research Projects 10
1.3.2 Synthesis or State-of-Practice Study 10
1.3.3 Continuation Study 10
1.3.4 Technical Assistance/Special Requests 10
1.3.5 Development Project 10
1.3.6 Technology Transfer 11
1.3.7 Implementation Initiatives 11
1.4 Overview of the Manual 11
SECTION 2.0- GOALS, ORGANIZATION AND PARTNERSHIPS 13
2.1 UDOT Strategic Goals 13
2.2 Research Policy 14
2.3 Strategic Management and Planning 15
2.3.1 Strategic Management Process 15
2.3.2 Strategic Management Products 15
2.4 Developing Customer Support 16
2.4.1 Process 16
2.4.2 Contacts 17
2.4.3 UDOT Committee Involvement 18
2.5 Placement within the Department Organization 18
2.6 Research Division Organization 18
2.6.1 Organizational Structure 18
2.6.2 Internally Available Resources 20
2.6.3 Externally Available Resources 20
2.7 Staff Training and Education 21
2.7.1 Project Management Methods 21
2.7.2 Ethics and Objectivity 21
2.7.3 Technical Writing 22
2.8 Partnerships with Related Programs 22
2.8.1 University Transportation Center Programs (UTC) 22
2.8.2 Local Technical Assistance Program (LTAP) 23
2.8.3 Strategic Highway Research Program (SHRP) and Long-Term Pavement Performance (LTPP) 23
2.9 National Research Organizations 24
2.9.1 Transportation Research Board (TRB) 24
2.9.2 National Cooperative Highway Research Program (NCHRP) 25
2.9.3 National Technology Transfer 26
2.9.4 National Implementation Activities 27
2.9.5 Partnerships with National Committees 27
2.9.6 Peer Exchange Process 28

SECTION 3- RESEARCH PROJECT MANAGEMENT AND CONDUCT 29
3.1 Overview 29
3.2 Utah Transportation Research Advisory Council (UTRAC) Process 29
3.2.1 Overview 29
3.2.2 Identification of Research Projects 30
3.2.3 The UTRAC Workshop 31
3.2.4 Projects Initiated by Senior Leaders 32
3.2.5 Pooled-Fund Projects 33
3.2.6 Final Work Program Project List 34
3.3 Literature Reviews 34
3.4 Project Identification Code (PIC) 34
3.5 Project Type Selection 36
3.5 Outreach Partnerships 37
3.6 Contract Preparation and Documents 37
3.7 Detailed Work Plans 38
3.7.1 Project Title 39
3.7.2 Statement of Problem 39
3.7.3 Problem Background 39
3.7.4 Questionnaires and Surveys 39
3.7.5 Study Objectives 40
3.7.6 Project Tasks 40
3.7.7 Schedule 40
3.7.8 Implementation Statement/Project Benefits 40
3.7.9 Champions 40
3.7.10 Project Manager 41
3.7.11 Technical Advisory Committee (TAC) 41
3.7.12 Principal Investigator (PI) 42
3.7.13 Project Team Membership and Requirements 42
3.7.14 Budget and Payment Schedule 42
3.8 Project Budget Preparation and Approval 43
3.9 Monitoring Project Progress 43
3.9.1 TAC Meetings and Management Oversight 43
3.9.2 Milestones of the Project 44
3.9.3 Deliverables 44
3.9.4 Invoices 44
3.10 Project Deliverables 44
3.10.1 Final Reports 44
3.10.2 Interim Reports 44
3.10.3 Executive Summaries 45
3.10.4 Presentations 45
3.10.5 Policies 45
3.10.6 Specifications, Special Provisions, Processes and Procedures 45
3.10.7 User's Manuals and Training Sessions 45
3.10.8 Software Packages and Web Sites 46
3.10.9 Test Results and Ownership 46
3.10.10 Publication Rights 46

3.10.11 Patents and Copyrights 47
3.11 Project Level Implementation Issues 47
3.12 Research Project Evaluation 47
3.12.1 Purpose 47
3.12.2 Process 48
3.12.3 Project Documentation 49
SECTION 4- WORK PROGRAM DOCUMENT AND APPROVAL 50
4.1 Work Program Overview 50
4.1.1 Categories of Research 50
4.1.2 Programming Proposed Initiatives 50
4.2 Program Deliverables 51
4.3 Program Balance 51
4.3.1 Factors Contributing to Program Balance 51
4.3.2 Balance Related to UDOT Strategic Goals 52
4.3.3 Resource Allocation by Functional Areas 52
4.3.4 Research Initiative Types 53
4.3.5 Engineering Solutions vs Political Decisions 53
SECTION 5- FUNDING SOURCES 55
5.1 State Planning and Research (SPR) 55
5.2 Special Federal Funding 55
5.3 Special Federal Matching Funds 56
5.4 State Funds 56
5.5 Pooled Funds 57
SECTION 6- DEVELOPMENT PROGRAM 58
6.1 Technology Transfer 58
6.1.1 Technology Transfer Activities 59
6.1.2 Technology Transfer Customers 60
6.1.3 Technology Transfer Partners 60
6.1.4 Technology Transfer Products 60
6.1.5 Benefits of Technology Transfer 60
6.1.6 Information Resources 61
6.1.7 UDOT Lester Wire Library 61
6.1.8 Transportation Research Information Service (TRIS) 62
6.1.9 Research in Progress (RIP) Database 63
6.1.10 Other Resources 63
6.1.11 Marketing Techniques 63
6.1.12 Demonstration Projects 64
6.1.13 Technical Assistance 64
6.1.14 Local Technical Assistance Program (LTAP) 65
6.1.15 Technology Scanning 65
6.1.16 Success of Technology Transfer and Implementation Efforts 65
6.1.17 Research Publications 67
6.1.18 Research Newsletter 67
6.2 Experimental Features 68
6.2.1 Experimental Feature Principal Investigator, Champion and Supplier 68
6.2.2 Work Plans 68

6.2.3 Experimental Features Design 69
6.2.4 Installation of Experimental Features 70
6.2.5 Laboratory Testing and Analysis 70
6.2.6 Test Sections and Field Testing 71
6.2.7 Data Collection and Analysis 71
6.2.8 Presenting and Reporting Results 72
6.2.9 Implementation of Experimental Features 72
6.2.10 Deliverables and Products 73
6.2.11 Maintaining Records 73
6.2.12 Termination of an Experimental Feature 73
6.3 New Product Evaluation 73
6.3.1 Product Evaluation Process 74
6.3.2 Deliverables and Products 75
6.3.3 Implementation and Feedback 76
6.3.4 Funding for the New Product Program 76
SECTION 7- IMPLEMENTATION PROGRAM 77
7.1 Implementation Program Functions 77
7.2 Problem Statement Implementation Plan 78
7.3 Scope of Work and Contract Related Implementation 78
7.4 Implementable Deliverables 79
7.4.1 Reports, Newsletters and Research Briefs 79
7.4.2 Training Initiatives 80
7.4.3 Specifications & Standards 80
7.5 Technical Advisory Committee (TAC) Role in Implementation 80
7.6 Implementation by Special UDOT Committees 81
7.7 Monitoring Implementation Activities 81
7.8 Facilitating the Implementation of Research Results 82
7.9 Experimental Projects and Demonstrations 83
7.10 Conferences, Workshops, and Meetings 83
7.11 Videoconferencing Programs 84
7.12 Agency Emphasis on Implementation 84
SECTION 8- PERFORMANCE MEASURES AND PROGRAM FEEDBACK 86
8.1 Program Performance Measures 86
8.1.1 Implementation Results 86
8.1.2 Milestones 87
8.1.3 Funding Adherence 87
8.1.4 Schedule Adherence 87
8.1.5 Benchmarking 87
8.2 Program Feedback 88
8.2.1 Peer Exchange Program 88
8.2.2 Exit Surveys 88
8.2.3 Benefit-Cost Studies 89
Appendix A- Examples of Web Pages 90
Appendix B- Research Forms 97
Please rate the following questions as: 100
5-very good, 4-good, 3-fair, 2-poor, 1-very poor 100

Appendix C- Guidelines for Preparing UDOT Research Reports 107
Appendix D- Contract Documents for Research Projects 115
ATTACHMENT A: Standard Terms and Conditions 115
ATTACHMENT B: Special Terms and Conditions 116
ATTACHMENT C: Scope of Work & Detailed Work Plan 127
Appendix E- UTRAC Workshop History 128
Appendix F- Examples of Political Decisions 129
BIBLIOGRAPHY 130

SECTION 1.0- INTRODUCTION

1.1 Purpose of the Research Manual

The Research Division exists to benefit the Utah Department of Transportation (UDOT), its employees, those who work with and for the Department, related agencies and groups, and most importantly the traveling public. The purpose of this manual is to improve the effectiveness of research efforts by identifying and describing Research Division functions and procedures.

This manual provides guidance on the following:

- Organization and role of the Research Division within the Department,
- Processes used to establish research priorities,
- Policies and procedures needed to manage research activities,
- Methods and processes required by those who perform research functions,
- Enhancing the usefulness and implementation potential of the research,
- Ensuring that short-term research results are incorporated in a long-term program,
- Assessing research using project and program accomplishments, and
- Determining the continuation potential or scope modification of a research project based on a periodic review of its progress.

1.2 Authority of the Research Program

Research is one of the principal missions of the first national highway program in the United States, and is the oldest continuous federal highway activity. The Federal Highway Act of 1921 authorized the first sustained fiscal support for highway research. Support for highway research was reaffirmed in the Federal-Aid Highway Act of 1962, which mandated funds for planning and research purposes only. Most recently, the "Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991", and in 2005 the "Safe, Accountable, Flexible, efficient Transportation Equity Act: A Legacy for Users (SAFETEA - LU)" have provided support for research. These congressional bills require that a minimum of 25 percent of the State Planning and Research (SPR) funds shall be expended on research, development and technology transfer activities.

The authority for the State research organization to use federal funds is found in 23 United States Code 307(c). The authority for the State to administer the SPR funds in the program is found in 23 Code of Federal Register 420, Subpart B. The Utah Department of Transportation set up the Research Division in the Project Development division with the intent to connect research to its primary users. UDOT has authorized the use of state construction funds for transportation research, noting the importance of research in Utah transportation.

1.3 Overview of the Research Division

The UDOT Research Division is charged with promoting, executing and implementing research activities within the Utah Department of Transportation, to further the mission of the Department and increase the Department's use of new products and techniques. Aided by the Federal Highway Administration, and in collaboration with other public and private entities, the Research Division manages a program funded by federal and state agencies toward these goals.

The major activities described in this manual that comprise the UDOT Research Division are as follows:

1.3.1 Research Projects

This is a systematic inquiry into a subject in order to discover or revise facts and usually includes analytical and experimental efforts to increase the understanding of causative relationships necessary for meeting the specific needs of the Department. In general the studies are longer-term efforts and are different from technical assistance or special requests described below. Research projects may be performed by a consultant, research staff member, or by a UDOT expert.

1.3.2 Synthesis or State-of-Practice Study

This is a study that examines all literature published on a specific topic and summarizes the results reported; such a study generally reports on the state of practice of the topic and gives recommendations regarding the best or most effective practices found by various organizations using the methods or products under study.

1.3.3 Continuation Study

This is used to designate, in the budget, the money required to continue research studies beyond the present fiscal year. It is an easy way of distinguishing new project budget requests from projects in progress that require continued funding.

1.3.4 Technical Assistance/Special Requests

This includes brief analyses, experiments, or literature searches for operating or administrative units to develop answers to specific and immediate questions. Such assistance is provided where special expertise or equipment is available in research. The effort usually results in a brief technical opinion or a short experimental project. The results are prepared for the requesting unit and generally are not formally published or distributed widely.

1.3.5 Development Project

This is the adaptation, modification, or testing of an idea, process, or product for practical use under field conditions. Development is a continuation of the research process and conducted to verify expected performance and improve the utility of the item.

1.3.6 Technology Transfer

This consists of post-research activities to inform and to encourage practical use of innovations. In its broadest sense, technology transfer can encompass any activity that causes an innovation to occur. The Research Division is generally responsible for dissemination of research results from within and outside the organization. This may include training, conferences, symposia, and other events to facilitate the flow of information regarding new and successful technologies that may improve the transportation services delivered by the Department or by others. Technology transfer activities may include informing other agencies about research and technology originating in the Department or acquiring technology information from others to be used by the Department. The Lester Wire Library serves a key role in many of these activities.

1.3.7 Implementation Initiatives

A specific work plan may be established to undertake the task needed to implement a research product (from within UDOT or from another agency) into practice. These major implementation activities should be documented in an Annual Work Program line item. Both the funding needed and the results of the initiative should be included in the report.

1.4 Overview of the Manual

The UDOT Research Manual of Instruction covers the complete process used by the Research Division, from program development through program evaluation, including technology transfer, new products evaluation and the management requirements needed to maintain an effective research program. The following sections of the manual are included:

Section 2- Goals, Organization, and Partnerships discusses the goals of the Research Program in Utah and its interactions with national transportation entities. Particular attention is given to the need for and development of strategic plans. The structural organization of research both within the unit and within the Department is summarized. It outlines a comprehensive training program for the staff, suggestions for resources necessary to maintain national professional contacts, administrative issues, and liability concerns.

This section discusses how the Research Division focuses on helping UDOT achieve its strategic goals. Details are also given of the options for customer support processes, and how they are used to increase the interactive nature of the research program.

Section 3- Research Project Management and Conduct defines the methods used to initiate, manage, and monitor research projects. This includes scope development, contract

preparation, monitoring of project progress, input by stakeholders, development of the final deliverables, and product implementation.

Section 4- Work Program Document and Approval details the process for the development of the Annual Work Program describing how the projects are developed, from problem statements to selection. It defines methods of evaluating and prioritizing projects. It lists the various components of the Department's Research program.

It also provides a program evaluation method to help UDOT leaders assess the effectiveness of the program. It offers evaluation techniques ranging from the work program achievement level through the implementation and economic benefit efforts to the on-site peer review. The peer exchange evaluation offers interaction and feedback that cannot be attained through the other methods. A descriptive narrative is also given of the elements of the work program.

Section 5- Funding Sources are listed and described that are available to the research programs. Funding from federal, state, academic, and private sources are summarized. It describes how these funds can be acquired, matched, and utilized to accomplish research initiatives.

Section 6- Development Program provides an overview of the Technology Transfer, Experimental Features, and New Products Evaluation Programs. The library sciences and archiving services is also included. It outlines how publications, information sources, literature searches, product archiving, technology marketing, instructional sessions, and expert advice can contribute to the success of every research and development endeavor.

The relationships these programs have with the UDOT regions and divisions are described. A summary is provided of how these activities and projects are initiated, carried out, utilized, and evaluated.

Section 7- Implementation Program discusses the strategies, tools, resources, and philosophies of implementing transportation research deliverables and products into practice. It offers suggestions on facilitating the implementation process through improved planning, monitoring, and interactive techniques.

Section 8- Performance Measures and Program Feedback processes and policies are described. How these tools are used to make improvements in the Research Division and UDOT in general is explained.

The Appendices contain examples of the web pages provided by the division, forms used by the staff to manage the program, guidelines on report preparation, and a history of the UTRAC Workshop. Examples of the deliverables associated with key processes and activities are included.

SECTION 2.0- GOALS, ORGANIZATION AND PARTNERSHIPS

2.1 UDOT Strategic Goals

The Utah Department of Transportation is a goal-oriented organization. The Department's Strategic Goals are exemplified in what are known as the "Final Four":

1. **Take Care of What We Have**
2. **Make the System Work Better**
3. **Improve Safety**
4. **Increase Capacity**

These strategic goals provide foresight and guidance for the groups and divisions within UDOT, including the Project Development group and the Research Division within it. UDOT managers must communicate what will be achieved and how to get it accomplished. This will require the involvement of the entire organization in managing its people, processes, and products toward the successful accomplishment of these goals. The Research Division is a key stakeholder in this effort.

Project Development gives further guidance to its personnel by identifying the UDOT Regions as their primary internal customers, and by setting goals and standards as follows:

1. **Have Excellent Customer Service**
2. **Be Technical Experts**
3. **Provide Effective Training**
4. **Have Continuous Self Improvement**
5. **Provide for Policies, Procedures, Standards and Specifications**
6. **Be a Leader for Tomorrow's Innovative Practices**

The Research Division is in a unique position because it can help achieve these goals more efficiently and effectively, by seeking and implementing innovative solutions. The Research Division's vision reflects this position and attitude:

"Tools for Better Transportation Tomorrow"

The Research Division's mission reflects the Department's goals listed previously, reinforcing the role of Research in achieving these goals:

"The Research Division will be at the forefront of transportation innovation, providing information, tools, and resources to improve planning, design, construction, operation and maintenance of Utah highways."

The Research Division investigates new ideas, innovations, methods and means to improve transportation in Utah. The mission focuses on providing information, tools and resources to improve all aspects of transportation.

2.2 Research Policy

The UDOT policies and procedures which are relevant to the Research Division are outlined below. These are detailed in the Department's administrative directives and policy manuals found on the Department's Innerweb.

UDOT Publications -- UDOT 05B-1
This policy has been established to ensure compliance with Utah Code 9-7-207(1)(a) & (3), which require all state agencies and state-supported colleges and universities to provide copies of publications to the Utah State Library Division for use in establishing and maintaining depository libraries.

In addition, the purpose of this policy is to maintain consistent deposits of UDOT publications into the Department of Transportation Lester F. Wire Memorial Library (UDOT Library).

Maintaining, Handling and Archiving Records -- UDOT 05B-3
This policy has been established to ensure a uniform policy for archiving and maintaining UDOT records in precise observance of state statutes.

Writing, Signing, and Handling Correspondence -- UDOT 05B-6
This policy has been established to ensure that a uniform protocol for mail handling is followed, so as to promote an efficient process at UDOT, and to observe mandated state statutes.

Library Services And Policies -- UDOT 05B-6
The Lester Farnsworth Wire Memorial Library exists primarily for the use of the employees of the Department of Transportation and the Department of Public Safety, with limited services to the community. The Wire Library is a specialized library and consists primarily of technical collections with some general works.

New Products Evaluation Panel -- UDOT 06F-2
A New Products Evaluation Panel is established for the purpose of:

1. Developing standards and policies for the statewide implementation of products that have been tested and approved for use by the Department.
2. Developing recommendations for specific projects on which approved products can be implemented.
3. Reviewing current technology on products that can be implemented within the Department, including review of SHRP products, Technology Transfer bulletins, etc.

Experimental Features and Evaluation of New Products -- UDOT 06F-3

To allow vendors, suppliers, and contractors an avenue to have their products considered for use in UDOT projects. To document product evaluation through research field performance testing as an experimental feature.

2.3 Strategic Management and Planning

The most important reason for a strategic approach to the Research Division's activities is to better meet our customers' needs. The Research Division studies internal and external customers and their businesses. Research management strives to know customers so well that the customers' problems can be anticipated. A priority of the Research Division is to have solutions to the customers' problems at the time the problems require a solution. Strategic management and particularly strategic planning allow research to position itself correctly—to be doing the right thing at the right time, and not just doing things right. Therefore, planning the research program is critical to research efforts.

2.3.1 Strategic Management Process

The seven essential components of the strategic management process for the Research Division are as follows:

1. Development of the Mission Statement—Specification of the organization's basic function and responsibility, why it exists, what it is striving to achieve, and who its customers are;
    Goals—Statements of ends the organization wants to achieve, but are not necessarily achievable in the near term; and
    Objectives—Specific things the organization plans to accomplish for each goal with measurable, quantifiable results.
2. Environmental Scan—Identification of the strengths and weaknesses of the organization's internal environment and the opportunities and threats presented by the external environment in which the organization operates.
3. Strategy Development—Statements of how the unit will work toward achieving its goals and objectives in terms of its processes, products, personnel, resources, and organizational structure.
4. Action Plan Development—A set of specific, accomplishable, detailed steps implementing a particular strategy; including schedule of work elements, completion dates, and delineation of responsibilities for each step of the plan.
5. Resource Allocation—All resources - personnel, financial, facilities and equipment - must be allocated in accordance with the organization's goals and objectives, strategies, and action plans.
6. Performance Measurement—Tracking implementation of the action plan, concurrent tracking of progress toward stated goals and objectives, and indication of changes needed.
7. Incentives Provision—Provision of a system of recognition and rewards.

2.3.2 Strategic Management Products

Both UDOT and Research Division managers must carry out continuous strategic management activities to ensure that the following elements are in place:

- Well-articulated, current mission statements, goals, and objectives;
- Organizational strategies for accomplishing the goals and objectives;
- Properly defined business activities;
- Business strategies;
- Business action plans;
- Strategically determined program budgets;
- Performance measures;
- Strengths, weaknesses, opportunities, and threat analyses

2.4 Developing Customer Support

The research function must respond to customer needs and solicit customer support internal and external to the UDOT. In Section 1.0- Introduction, it was stated that the Research Division exists is to improve planning, design, construction, operation, and maintenance of Utah's highways. Attaining this goal requires the support of our customers and stakeholders. Their support can best be achieved by involving them in the process of developing the program and generating the products. This ensures that their needs are considered and they are satisfied at all times.

The success of a research program hinges on its ability to develop strong and lasting interactive relationships with all the beneficiaries of research. Outreach to its partners assists the Research Division in strengthening program development, consensus building, implementation assistance, technical input, and the bolstering of partnerships.

2.4.1 Process

2.4.1.A Research Partners

Research Division partners fit in four major categories: Investigators, Technical Experts, Champions, and Funding Constituents. Five groups constitute these categories:

- Consultants and Contractors
- Academia (Universities and Colleges)
- Public Agencies (Including UDOT)
- Non-profit organizations
- Transportation System Users

Research partners help the research program in many ways, from performing research to evaluating it, from identifying research needs to implementing research results. Many partners provide invaluable services contributing to the success of the research program.

2.4.1.B Forums for Including Research Partners

The Research Division works closely with our partners to help identify needs and solutions. This relationship ranges from informal communication and collaboration, to formal meetings and workshops. The primary formal interface is the annual prioritization workshop, known as the UTRAC Workshop, which will be described in Section 4. Most other formal meetings are directly related to projects.

The Research Division makes annual visits to the UDOT Region offices to communicate with customers, assess their needs, discuss progress on projects, offer insights into ongoing activities, and receive feedback. Research leaders also regularly visit the major universities that conduct research for the Department to maintain relationships, improve communication and strengthen partnerships.

2.4.1.C Customer Surveys

The Project Development Group executes an annual customer survey. Feedback from this survey provides the Research Division and other divisions in the group with insight into customer needs and attitudes. These surveys help the Research Division improve service and response.

Surveys are also distributed at the end of each major project to determine what went well and what improvements in project management can be made. A survey is completed by the TAC members, champions, end users of the products, and any other stakeholders that the project manager feels can provide useful information. A copy of the survey form is included in Appendix B. The survey results are compiled and evaluated by research administrators.

2.4.2 Contacts

The Research Division maintains contacts with research experts and research management peers throughout the nation. Primary among these are the organizations listed in Section 2.8, including the Transportation Research Board Conduct of Research Committee, the Research Advisory Committee (RAC) of the AASHTO Standing Committee on Research (SCOR), and the Regional RAC organizations. Peer exchanges increase the effectiveness of the Department's research program management.

The RAC Handbook, Chapters 5 and 6, list contacts for technical issues as follows:

- RAC and SCOR member names and addresses,
- AASHTO staff contacts,
- National Transportation Product Evaluation Program (NTPEP) contacts,
- NCHRP staff,
- TRB state representatives,
- TRB Conduct of Research Committee membership,
- FHWA and state SHRP implementation coordinators,
- FHWA participation in technology programs,
- Highway Innovative Technology Evaluation Center (HITEC) state contacts, and
- FHWA regional research and technology engineers

2.4.3 UDOT Committee Involvement

In addition to information disseminated in the research committees, it is important for research staff to attend other committees within the Department. Regular attendance at these meetings can keep the research staff informed about critical issues facing each discipline, and serve as a research liaison to the group. Committees that should receive research staff involvement are:

- Transportation Safety
- Work zone traffic control
- Operations Engineers
- Pavement Maintenance
- Transportation Planning
- Highway and Pavement Design
- Materials Engineers
- Transportation environmental issues
- Information Management and GIS
- Asset and Pavement Management
- Innovative Finance and Statewide Planning

2.5 Placement within the Department Organization

Both formal and informal interaction of the Research Division within the Department are important to accomplishing its RD&T mission and goals. The formal structure is the location of the Research Division in the Project Development Group. The informal structure is the perceived fit of research into the Department based on the function it serves and its impact on the Department mission.

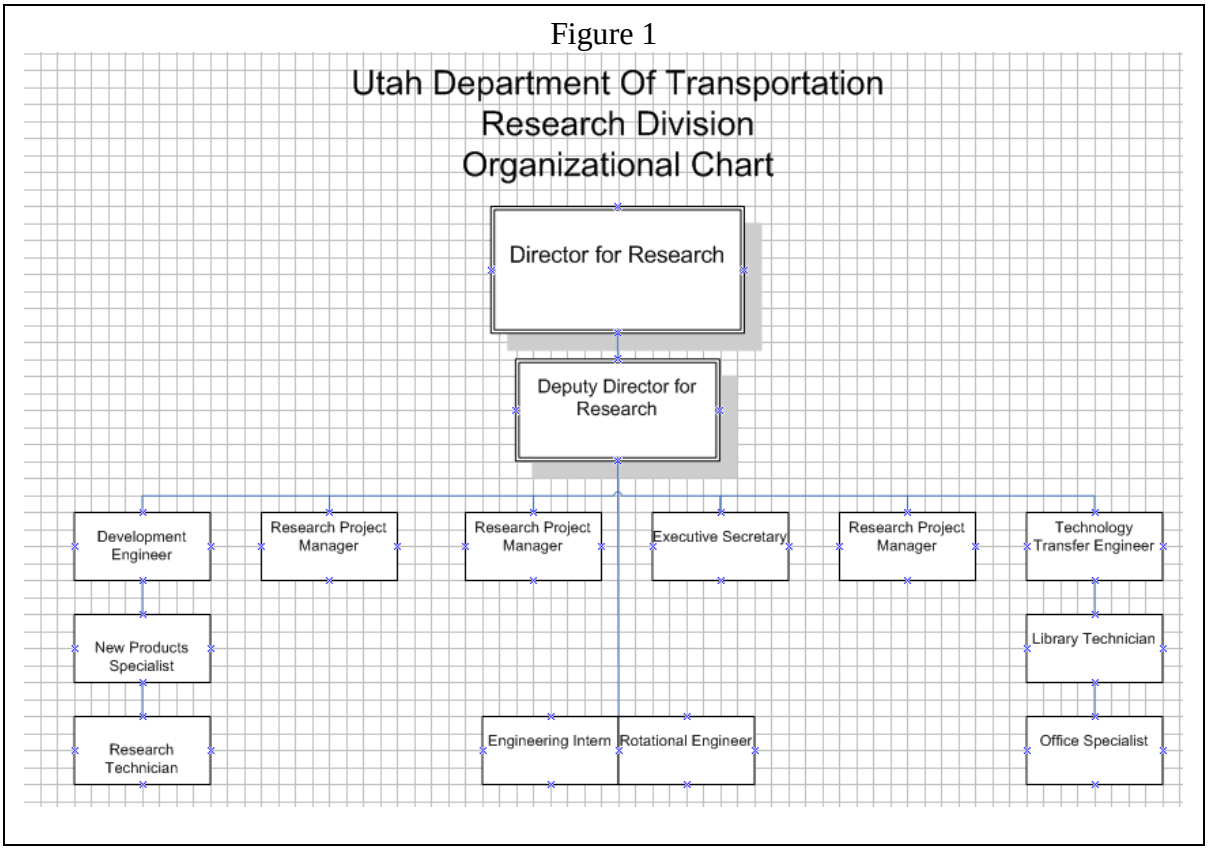
Research should maintain an effective place within the informal structure of the Department. This "networking" within UDOT is an important function for the Research Staff and others promoting innovative transportation concepts. The process of innovation usually does not flow through the reporting hierarchy defined by the organization chart. Topics requiring attention that may soon develop into bona fide research needs, users willing to implement a new technology, funds available for technical research, and other opportunities are often learned through a presence in the informal structure and communications within the Department.

2.6 Research Division Organization

2.6.1 Organizational Structure

A chart of the organizational structure of the Research Division is shown in Figure 1. The chart shows formal line responsibilities, project teams and matrix relationships with those inside and outside the Research Division.

Figure 1


Utah Department Of Transportation
Research Division
Organizational Chart
Director for Research
Deputy Director for Research
Development Engineer
Research Project Manager
Research Project Manager
Executive Secretary
Research Project Manager
Technology Transfer Engineer
New Products Specialist
Library Technician
Research Technician
Engineering Intern
Rotational Engineer
Office Specialist

The Research Division maintains activities in three principal areas as follows:

- Applied Transportation Research Projects
- Experimental Features and Product Evaluation
- Technology Transfer and Implementation

2.6.2 Internally Available Resources

Available internal resources of the UDOT Research Program are: personnel, equipment, facilities, and funding.

2.6.2.A Personnel

The Research Division focuses on ten areas: construction, maintenance, materials/pavements, environmental, planning & asset management, traffic & safety, geotechnical, structural, hydraulics, and engineering technology. Project managers should be competent in one or more focus areas to provide expertise and technical management. Support staff should be adequate to maximize time and effort spent by the professional/technical staff.

2.6.2.B Equipment

The research activities are limited to project management and researching properties of some experimental features. The research division relies on the principal investigator to have all equipment needed to conduct the commissioned research. Research Division equipment is limited to visual data recording instrumentation, digital cameras, computers, and a vehicle.

2.6.2.C Facilities

The UDOT Research Division includes office spaces for all the project managers and support staff. The Lester Wire Library provides resources for technology transfer activities and houses a wide range of research publications.

2.6.2.D Funding

The Research Division utilizes a wide scope of research funding. Some funding sources are allocated on an annual basis, while others are acquired through applications and competitive processes. A complete description of the more common sources of funding for transportation research is provided in Section 5.

2.6.3 Externally Available Resources

Resources from outside of UDOT provide the Research Division with enhanced capabilities not available within the Department. The division contracts with federal, university, other governmental agencies, and the private sector to obtain the resources as needed to meet its goals. This includes personnel, equipment, laboratory testing, office space, and conference facilities.

A high degree of contact is maintained with outside resources for research coordination, prevention of duplication of research effort, enhancement of technical expertise, and an increase

in available knowledge. A network of highly qualified professionals as well as a broad scope of expertise is necessary to support cost-effective and technically superior research initiatives.

The division seeks cooperative arrangements for the use of very costly equipment or infrequently used resources that draw ineffectively on the research budget. This network of resources includes the following:

- Other state research staff members and technical experts;
- FHWA division, regional, and headquarters staff including the Turner-Fairbanks Highway Research Center;
- The Transportation Research Board (TRB);
- The American Association for State Highway and Transportation Officials (AASHTO);
- The American Society of Testing and Materials (ASTM);
- The National Institute for Standards and Technology (NIST);
- Professional and trade associations;
- Academic institutions; and
- The consulting community

2.7 Staff Training and Education

The success of the research program, the usefulness of research products, and the growth of the research staff are enhanced through staff education and training. The work environment and influences affecting personnel must foster individual growth.

Educational and training needs may be pursued for staff in many areas offered by the Human Resources staff. Specific training that is especially useful for the Research Staff are in the following areas:

2.7.1 Project Management Methods

Good project management skills are important for the managers and engineers in the Research Division. Project management training is available through various sources in Utah and at a national level. The major universities in the state offer continuing education courses on managing engineering projects. National organizations such as the TRB conduct project management training on a regular basis.

These courses develop expertise in areas such as proposal preparation, expert network building, progress tracking, budget management, problem solving, legal issues, multitasking, and other valuable skills.

2.7.2 Ethics and Objectivity

One of the most important aspects of the research environment is technical objectivity. It is absolutely crucial that the conduct of research tasks be carried out with complete impartiality. There is no place in the field of research for preconceived conclusions. When objectivity is lost it usually unintentional, but deliberate bias does occur.

Training is needed to ensure that staff can conduct an assessment of the objectivity of the work in the following:

- Problem statements
- Work plans
- Research methodology
- Reports
- Specifications
- Policies

Another crucial aspect of any research endeavor is engineering ethics. Ultimately the research staff is judged according to a high standard of professional conduct and a strict moral code. These standards are intended to ensure that the research products are worthy of universal acceptance. Training in ethical behavior is needed in the following areas:

- Protection of researchers integrity
- Security for research subjects
- Confidentiality of documents
- Privacy of subjects
- Anonymity of researchers with industry
- Anonymity of topics

2.7.3 Technical Writing

It is important for the engineers and managers in the Research Division to develop good technical writing skills. They will better provide the proposals, correspondence, and deliverables of research initiatives if they can communicate well in engineering terms and language.

Selected technical writing courses provide the training needed to write specifications, plans, laboratory reports, and other technical documents. These courses are available through any of the three universities in Utah, or from private training centers in the state.

2.8 Partnerships with Related Programs

2.8.1 University Transportation Center Programs (UTC)

The U.S. DOT established the University Transportation Centers Program (UTC) in 1967. The originating legislation established ten regional centers, and ISTEA added three additional national centers, SAFETEA-LU added a number of "Tier II" centers.

The goals of the UTC are as follows:

- Provide interdisciplinary education in all modes of transportation to tomorrow's professionals and to advance the skills of today's professionals;
- Address current and future transportation challenges and issues through applied, interdisciplinary, and basic transportation research covering all modes of transportation; and

- Disseminate the results of the research through carefully planned programs of technology transfer and early involvement with the prospective users of the products of the research.

The legislation provides federal funding for the centers on an annual basis, but these funds must be matched by non-federal monies. The Department can be a source for matching research funding for the UTC. Both hard funding and soft match are eligible. In cases where the UTC selects beneficial topics to UDOT, the Research Division could receive twice the effort for the funding it contributes. Utah State University has a Tier II center, and the University of Utah is a partner with four other universities in the Mountain Plains Consortium (MPC).

2.8.2 Local Technical Assistance Program (LTAP)

The Local Technical Assistance Program (LTAP) is a high-profile technology transfer program sponsored by FHWA. The program, established in 1961, encourages cost-effective improvements to roads and bridges owned and maintained by local government.

Federal-aid LTAP funds are available for 50 percent of the program funding; the state and the LTAP Center provide the match. Through training courses, production of user's manuals, on-site demonstrations, and a strong network of technical expertise available to the local governments, the program furthers the implementation of highway innovations at the local level. The funds available and the people-intensive focus enable new processes, methods, and other innovations to be more easily applied to local highway practice.

The LTAP Center is located at Utah State University, and staffed by non-UDOT personnel. The Research Division functions as a program administrative director and technical advisor. The Center provides proposals of work for the coming performance time frame, and is awarded funds based on the proposals. The Center has a close association with Department technical personnel, who facilitate the flow of technical information to the Center and its customers.

2.8.3 Strategic Highway Research Program (SHRP) and Long-Term Pavement Performance (LTPP)

The FHWA Office of Technology Assessment (OTA) undertook the continuation efforts for the Strategic Highway Research Program (SHRP) implementation activities. Implementation packages are prepared by FHWA for various SHRP products. These "showcase" products are available to the Department. The state has an aggressive effort to implement the products of SHRP, purchase equipment, conduct pilot and experimental projects, and initiate internal task forces to assist with the implementation effort.

The Research Division has the responsibility to oversee the Department's SHRP implementation efforts. The SHRP Implementation Coordinator in research is the contact point within the Department for all SHRP implementation activities. The SPR Work Program has a line item for implementation activities.

The Department is also conducting research on the Long-Term Pavement Performance (LTPP) module of SHRP. Test sections associated with the SHRP were installed in many locations in Utah. The Department is monitoring and evaluating the performance of these sections. The Research Division funds these LTPP SHRP activities out of SPR money.

2.9 National Research Organizations

2.9.1 Transportation Research Board (TRB)

TRB is a unit of the National Research Council, which is the principal working arm of the corporate institution that includes the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

TRB began in the early 1920s as the Highway Research Board. The Board's name was changed in 1974 to the Transportation Research Board in recognition of its broadened approach to transportation problems. TRB's purpose today is to bring scientific and technical knowledge to bear on transportation problems by encouraging and conducting research and disseminating information in the following areas:

- The planning, designing, construction, operational aspects, safety, and maintenance of transportation facilities and their components;
- The economics, financing, and administration of transportation facilities and services;
- The interaction of transportation systems with one another and with the physical, economic, and social environment that they are designed to serve.

2.9.1.A TRB State Representatives

The Research Division represents the Department to provide liaison with the Board. A designated representative informs the Department of TRB activities, receives all TRB publications, and advises TRB of current and contemplated research activities of the department. General responsibilities of the TRB State Representative are as follows:

- Maintain an awareness of general procedures concerning the operation of TRB committees, NCHRP, Transportation Research Information Service (TRIS), and other special activities;
- Keep others in the Department and other related state agencies informed of TRB activities;
- Recommend qualified people for membership in TRB committees and panels;
- Update and submit selective distribution forms for TRB publications annually;
- Update and return the information services (TRIS) summaries of ongoing research projects, and report initiation of new research;
- Supply TRB copies of the Department's research reports and other reports of research as appropriate;
- Coordinate responses to TRB-initiated solicitations and questionnaires;
- Assist TRB staff members in scheduling meetings with Department personnel during field visits;
- Submit items for consideration for the TRNews; and

- Encourage Department personnel to submit papers for presentation at TRB meetings and for publication.

2.9.1.B Transportation Research Information Service (TRIS)

TRB maintains and operates the TRIS. This service is a computerized information storage and retrieval system that contains over 400,000 abstracts of published transportation research articles and reports and summaries of ongoing research projects. The AASHTO Research Advisory Committee Research-in-Progress (RIP) database is incorporated into TRIS.

The Research Division searches the system directly via AASHTO-VAN online services or indirectly by making requests through the TRIS staff. Other services, such as topical searches, are provided upon request. In addition, project summaries and abstracts of completed transportation research appear periodically in various TRB publications.

2.9.1.C TRB Library Services

The TRB Library provides the Department with access to an extensive collection of transportation literature and provides assistance in locating information available in other libraries. The library is located in the TRB offices.

2.9.1.D TRB Publications

TRB distributes a variety of publications. As a member state, the Department receives a full complement of the publications. The TRB state representative receives these publications and is responsible for informing TRB of the needs and changes for future publications. TRB annually asks the state representative for an update to the publication distribution. In addition to NCHRP publications described in Section 4.4.2, TRB publishes the following:

- TR News, a bimonthly magazine of TRB and transportation community activities;
- The Transportation Research Record series, documenting research papers presented at the TRB Annual Meeting in January each year;
- The Transportation Research Circular series, documenting presentations and committee activities; and
- Major policy studies and other special projects conducted through the work of project committees, staff, and consultants.

Each year the Department contributes to the general support of TRB. The contribution acknowledges that a minimum level of service from TRB is available. The support is contributed from the federal-aid SPR program allocation. The TRB general support is an established line item in the SPR Annual Work Program. The Research Division acts as the Department's promoter of TRB activities; Department staff members are encouraged to participate in all TRB conferences and serve on their committees.

2.9.2 National Cooperative Highway Research Program (NCHRP)

NCHRP is supported on a continuing basis through the contribution of funds from the AASHTO Member Departments. Annually, the Department voluntarily contributes 5.5 percent of the funds available through the federal-aid SPR allocation. The Department executes an FHWA PR-2.1

form, which enables transfer of federal-aid funds directly to TRB without them first having to be transferred to the State. A copy of the PR-2.1 form is in the appendix.

NCHRP was created in 1962 to accelerate research on acute problems that affect highway planning, design, construction, operation, and maintenance nationwide. Pooling of state resources enables a concerted attack on the major problems of concern to the Member Departments. NCHRP is sponsored by AASHTO in cooperation with FHWA and is administered by the Cooperative Research Programs Division of TRB.

The AASHTO Standing Committee on Research (SCOR), with input from the Research Advisory Committee (RAC), is responsible for the program. NCHRP addresses the full spectrum of highway transportation technical areas. The program categorizes problems into eight research fields and subdivides these fields into 25 technical problem areas. These are shown in Attachment in the appendix.

The important dates of the Program Formulation Cycle are as follows:

- May 30 Deadline for First Stage Problem Statement Submittals by AASHTO Member Department.
- October 31 Deadline for Second Stage Problem Statement Submittals.
- April 30 SCOR recommendations are forwarded to AASHTO for Member Department approval through ballot; approved program referred to TRB, Cooperative Research Programs Division, for administration.

NCHRP Publications include the following:

- NCHRP Reports: publications documenting selected research performance, findings, and conclusions. NCHRP reports are a formal series and issued by number.
- NCHRP Syntheses: a compendium of reports of the best knowledge available on the practices found to be the most successful in solving specific problems. These reports are not as detailed as the NCHRP Report series. Syntheses are also issued by number.
- NCHRP Research Results Digests: timely newsletter-format documents used to convey research findings before the completion of a project.
- NCHRP Legal Research Digests: papers compiled in a newsletter-format on pertinent legal issues.

2.9.3 National Technology Transfer

The Research Division performs technology transfer activities for the Department and transfers the technology developed nationally, by other state agencies, and through the efforts of the UDOT research program. A few methods used by research to transfer technology are as follows:

- Training Courses—either developed in conjunction with a specific research project or through the National Highway Institute or other education and development avenues;
- Department and National Libraries—an extensive collection of transportation-related literature and capabilities for data search and retrieval (for research as well as the Department);

- Report and Publication Distribution—research reports and other materials generated by RD&T activities;
- Research Project Results and Status—input to TRIS database;
- Promotion of seminars, conferences, exhibitions, and other opportunities for disseminating research results materials, either in-house or outside of the Department;

The Research Division performs or coordinates technology transfer activities and encourages others in the Department to participate in them. Research funds are often used to support these activities when they are performed for operating units in the Department.

2.9.4 National Implementation Activities

The research work program, and particularly the SPR work program, may contain an implementation effort as a discrete item. The Research Division includes funds in its budget for implementation of research findings, because it is uncommon for research findings to be put into practice without additional cost or effort. The availability of implementation funds can immediately remove financial barriers that might otherwise prevent implementation of an innovation. Implementation monies can be used for some aspects of technology transfer and other appropriate activities fostering the adoption of research findings.

As noted in Section 7, Implementation Program, funds are programmed for staff, facilities, testing, adaptation, packaging, and promotion of new technology, particularly if a large-scale effort is expected.

2.9.5 Partnerships with National Committees

Several national committees provide useful research program management materials and opportunities for peer exchange among research and transportation professionals. These committees are as follows:

1-Conduct of Research Committee (A5001), Transportation Research Board (TRB), Technical Activities Division

This organization increases the quality and effectiveness of research through encouraging better planning, management, and operational practices in organizations engaged in transportation research. The committee assists TRB in stimulating research and serving as a national clearinghouse for research activities.

The committee is composed of 25 research and technology professionals from private, university, and public sector organizations; it has an active “friends of the committee” group that is open to anyone interested in the committee's activities. The committee sponsors sessions at the TRB Annual Meeting, holds a general committee meeting at that time, and holds periodic mid-summer meetings. Materials discussed at these meetings and personal contacts are important sources of research program management information. For further information see the annually published TRB Directory.

2-Research Advisory Committee (RAC) of the AASHTO Standing Committee on Research (SCOR) and the Four Regional Research Advisory Committees

RAC provides a forum for state research directors in which they participate in AASHTO research activities and support SCOR. RAC maintains an overview of all State-related transportation research programs using federal funds and is informed of State-only funded research efforts. It provides a network in which the results of such research is shared. A national meeting of RAC is held during the TRB Annual Meeting and at a summer meeting on even-numbered years. Regional RACs are composed of the RAC membership from states within the respective four Regional Associations of State Highway and Transportation Officials. Regional RACs meet annually—within region in odd-numbered years and as an adjunct to the national RAC meeting in even-numbered years. Because of its membership, this organization is a good source of program management information.

3-Additional committees are listed in the RAC Handbook-A Guide for Committee Members. The handbook is available from the TRB Cooperative Research Programs and is retained in the research office. The committees of AASHTO, TRB, ASTM, ITE, ITS, and other organizations are important to the Research Division's ability to assess current thinking on issues.

2.9.6 Peer Exchange Process

In conjunction with the FHWA RD&T Program Management process, peer exchanges of Department Research Divisions may be made once every three years. Sufficient resources are set aside under this line item in the Annual Work Program to provide for the peer exchange of the Department's research program and the time requirements of serving on an exchange team to another state.

SECTION 3- RESEARCH PROJECT MANAGEMENT AND CONDUCT

3.1 Overview

The Research Division administers the selection, funding, management, and documentation of applied transportation research projects for the Department. Projects are typically selected through the UTRAC process, by administrative mandate by senior leaders in the Department, or through the pooled-fund request process.

The overall research program and budget is described in the Annual Work Program (Section 4). A research project manager (PM) and a Technical Advisory committee (TAC) are selected to oversee each project. In order to facilitate the tracking of research efforts, each project is assigned a Project Identification Code (PIC). This designation is used throughout the life of the project.

3.2 Utah Transportation Research Advisory Council (UTRAC) Process

3.2.1 Overview

Research activities cover a broad range of objectives and employ varied methodologies and approaches. The primary goal of research activities is to identify the needs of the Department and to meet those needs with techniques, information, tools, products, resources, and training. These activities advance the state-of-the-art, identify useful scientific tools, and evaluate materials and processes, which can bring innovation to our work. Research efforts are generally applied, that is, they focus on results that can be implemented in the near future.

Historically, research objectives have included measurement of material properties and their longevity, verification of new and extended design practices, evaluation of the effectiveness of current procedures, application of new technologies, consideration of economic benefits, and development of policy. Topics have included structures, foundations, pavements, roadway geometrics and design, hydraulics and hydrology, traffic planning, traffic safety, intelligent traffic systems, environmental considerations and impacts, maintenance, and construction processes and management.

Methodologies used to advance research projects include literature searches, surveys, synthesis of practice, computation and analysis, physical and analytical modeling, physical testing, and long-term monitoring. Studies can be brief and fairly superficial, long-term and complex, or anywhere in between, depending on the goals of the research.

The benefits of research are also varied. Some projects demonstrate that a new technique or tool is not effective, not useful, or not applicable to the Department. This result forestalls the use of this new approach and saves time and money in later failed efforts. Some projects validate processes that are already in use, and verify that these techniques are still applicable and valuable. These projects sometimes determine that minor changes will yield higher efficiency, or produce manuals, specifications or training to improve the use of existing procedures. Other projects demonstrate that new materials, techniques or tools are successful and applicable, and encourage those to be implemented in the Department. Previous studies have suggested that every dollar invested in research within the Department yields twelve dollars of return, on the average.

3.2.2 Identification of Research Projects

The importance of researching the most pressing issues facing the traveling public cannot be over emphasized. The value of research is diminished if the topics studied are of lesser worth to the champions and end-users. For this reason UDOT dedicates significant resources each year to making sure the most appropriate topics are funded.

The selection of research projects to be undertaken usually follows one of several processes. The primary process is the UTRAC Workshop, from an acronym for the Utah Transportation Research Advisory Council. Other sources of research projects include directives from senior Department leaders or the state legislature, projects associated with special funding opportunities (Innovative Bridge, Pooled Fund, the I-15 National Test Bed, etc.), and projects developed as follow-on phases of future projects.

It is important to utilize a team approach to the problem selection process. Although each problem statement is generated and submitted by a key author, a great deal of peer review, team building, and brainstorming is required to optimize the research approach and concepts. The team must have enough information to be confident that the project is needed, justified, and has a reasonable chance for success.

The UTRAC Workshop is a collaborative, annual workshop, organized to assess the needs of the Department and define research projects to address those needs. The UTRAC Workshop was initiated in 1993, and has been a very successful process. The process has been modified several times, and underwent some significant revisions in 2005. The revised process initiated in 2005 was recognized with an "AASHTO President's Award for Research".

The detailed process used to prioritize research projects each year, including the UTRAC Workshop, is presented in the annual UTRAC Workshop Proceedings for that year. That document includes a complete list of Problem Statements evaluated and selected. The UTRAC process is outlined in the following section.

3.2.3 The UTRAC Workshop

The key steps employed in the UTRAC research prioritization process at UDOT are shown below. Although the workshop plays a central role in the process, a number of steps are needed before and after the workshop to make the process complete. The steps are:

1. Needs are evaluated in ten separate discipline areas. A UDOT key leader is selected to lead each group, and a Research Division contact person works with each group. The discipline areas are:
    - Construction
    - Engineering Technology
    - Environmental
    - Geotechnical
    - Hydraulics
    - ITS & Traffic and Safety
    - Maintenance
    - Materials & Pavements
    - Planning & Asset Mgt
    - Structural

    It is important to assemble a team within each of the ten groups that has a broad range of expertise, diversity, and organizational breadth. The usefulness of the voting process conducted during the UTRAC Workshop is dependent on informed group members. Ideally members of the group should have representatives from the following:

    - UDOT Division Personnel
    - UDOT Region Managers
    - University Experts
    - FHWA Officials
    - Private Sector Partners
    - Industry Representatives
    - MPO Officials
    - UTC Personnel, and
    - Other key partners

2. Problem Statements are developed by UDOT personnel, university researchers, consultants, and any of the other experts listed above to address important needs or problems within the Department. Private citizens occasionally submit problem Statement forms. These Problem Statements define a need within the Department, and also identify a key UDOT Champion who will direct the research, a basic scope of work, and a plan for implementation. Problem statements are collected by the group leader for each discipline group, and shared with the Research Division staff contact.

3. The Research Division staff contact for each discipline group reviews the submitted Problem Statements. Their review includes a literature search to determine if similar work has been performed in Utah or elsewhere, or if significant knowledge on the topic is available as the Problem Statement is discussed. The scopes are evaluated to insure that well-defined work tasks and clear deliverables are envisioned, and that implementation is feasible. It is very important for the group to agree on an appropriate funding level for the project prior to the final group vote.

4. The one-day UTRAC Workshop is convened to review the Problem Statements and prioritize them. The workshop includes about 150 people from UDOT, FHWA, key consulting and construction firms, the three research universities in Utah, other state agencies, and the public. The workshop is usually held in March. During the workshop,

each of the discipline area groups meet to discuss, evaluate, and prioritize the Problem Statements.

5. The Problem Statements with the highest priority are listed for potential funding by the Research Program Manager, and the list is approved by Senior Leaders. A Project Identification Code (PIC) is assigned to each project.

6. Available research funding (from Federal and State sources) is applied to the highest priority projects on the list of prioritized Problem Statements, and a Project Manager (PM) is assigned to manage each funded project, along with the UDOT Champion. The research funding comes from the annual Research Division project budget.

7. Principal Investigators are selected, a Technical Advisory Committee (TAC) is created to provide oversight to each research project, the project scope is refined, and contracts are written for the work.

8. During the duration of the project, the Champion, TAC, and PM monitor the work, get progress reports, and prepare for implementation of the results. Project durations range from six months to several years, depending on the project.

9. Projects are completed, final reports are provided, edited and published, and tools are provided. Implementation is initiated with the Champion and other UDOT participants.

As indicated, the list of projects identified and prioritized by the workshop participants is reviewed and approved by senior leaders in the Department. This provides the opportunity for those leaders to modify priorities, remove projects, or add projects that better support the strategic direction and goals of the Department.

3.2.4 Projects Initiated by Senior Leaders

Key leaders within the Department often administratively mandate research initiatives. These requests could result in the initiation of any of the projects or programs within the Research Division. Full research projects that are administratively mandated may be given a higher priority than projects from the UTRAC process.

A special requests line item is established each year in the Annual Work Program to reserve funding for other important activities. These projects usually require a quick response and are often aimed at a crucial issue facing the Department. Special requests could result in a state-of-the-practice report, a specification, a new or revised policy, a technical memorandum on an issue, or other deliverable.

Research projects are sometimes initiated by various Divisions within the Department as a result of their efforts to secure outside funding. In many cases, the Research Division becomes involved in the management of these projects. Examples include the annual Innovative Bridge and Highways for Life programs operated by the FHWA, instituted to encourage innovative techniques, methods and materials in the construction and operation of highway bridges.

Another special program was the I-15 National Test Bed, a special, multi-year appropriation from Congress to take advantage of research opportunities on the I-15 Reconstruction Project in Salt Lake County in the late 1990s.

3.2.5 Pooled-Fund Projects

Another source of research projects is the Pooled-Fund Program, also operated by the FHWA. Pooled-Fund projects are an excellent tool for states to pool their resources to accomplish common purposes. A great deal of research funding is saved each year by conducting one project on an issue rather than each state conducting their own study.

3.2.5.A Pooled-Fund Solicitation

Any state or the FHWA can initiate a Pooled-Fund project by simply soliciting interest from other agencies. After the solicitation, interested parties contribute funds to a central account, and jointly participate in the management and oversight of the project. The original solicitor is usually the leader and manager of the Pooled Fund project. Since these projects arise throughout the year, funding is applied to individual projects from Research Division resources at the discretion of the Research Director.

The most common way for a Pooled-Fund topic to be introduced to UDOT is through an email to the RAC member. A national pooled-fund web site has been created to supply information on all Pooled-Fund proposals from one source.

3.2.5.B Pooled-Fund Project Approval

The appropriate UDOT technical experts are approached for their input on the importance and applicability of the solicitation topic. The criteria used to recommend UDOT's participation in the pooled-Fund project are as follows:

1- The value of the project deliverables to UDOT's core business practices.
2- Implementation potential in Utah due to significant involvement by UDOT experts.
3- Quality project work plan and reasonable chance for success.
4- Appropriateness of the project budget compared to the benefits.
5- Availability of funding sources.

3.2.5.C Allocating Funds for Pooled-Fund Projects

Once UDOT technical experts and/or administrators express interest in participating in a pooled-fund project, funding must be identified for UDOT's contribution to the project. Typically the lead state has identified an amount that a state should contribute to be involved in the project, but occasionally the contribution can be any significant amount that the state can identify from its budget.

Resources other than funding may also be contributed to a pooled-fund project. There are many advantages for the department if local materials, test sections, laboratory testing, highway products, traffic control, and expertise are part of the project. It is strongly recommended that a UDOT expert be part of the project advisory committee to help with local issues especially implementation.

The Research Division can use funding from a Pooled-Fund Projects line item, the Special Projects line item, or any other funding source appropriate for the topic area. When large contributions are involved it is customary for the UDOT Division requesting participation in the project to contribute all or part of the match. A target pooled-fund budget for UDOT for any given year has been in the range of $50,000 to $100,000.

3.2.6 Final Work Program Project List

The UTRAC prioritization process, augmented by the other means of selecting important research projects, results in a listing of projects to be funded for the next fiscal year. This list, along with relevant background information on these projects and information on on-going projects selected in previous years, are included in the annual Research Work Program for approval by the FHWA.

3.3 Literature Reviews

The purpose of the literature search is to obtain relevant background information on problem statements, special requests, and other key issues facing the Department. The literature search can be a tool in providing early implementation to an existing problem without conducting a formal research effort. Many sources of information are available and should be utilized not only during the initial investigation, but throughout the research endeavor to make the final product as current and complete as possible.

A literature search should be conducted for each of the following aspects of research, and conducted by the person listed:

- Research Problem Statement- Project Manager
- Work Plan Development- Principal Investigator
- Special Request- Technology Transfer Engineer/Staff Expert/Consultant
- State-of-the-Practice Review- Technology Transfer Engineer/Staff Expert/Consultant

Where appropriate the assigned expert or project team should begin with the literature search conducted during the UTRAC Problem Statement selection process. A more detailed version of the literature search should be produced to allow a more complete analysis of what type of project should be programmed, what deliverables are suitable, and information needed to prepare a detailed work plan.

3.4 Project Identification Code (PIC)

The Project Identification Code (PIC) is used to track a research initiative throughout its development. It is very common for a project to be modified in terms of title, scope, and stage of development and for the "project phase number" (code used for funding) to change each fiscal year. It is important to track a topic from problem statement through scope of work,

contract, deliverables, and implementation. The PIC is used as this tracking mechanism by the Research Division.

The PIC number is assigned by the Research Program Manager when a problem statement or other project is initiated. It reflects the source of the project, the year it was introduced, and a sequential number during that year. A PIC number may be assigned even though the project was not funded or completed; numbers are usually assigned at project initiation, before funding or completion are known. The code takes the following form:

GGYY.XXX

where the following attributes are represented:

GG = Project Generation or origin, consisting of the following types:

- AM - Administrative Mandate: a project requested by the UDOT administration or upper level management
- IB - Innovative Bridge projects
- MP - Miscellaneous projects
- MPC - Mountain Plains Consortium: projects initiated through matching funds from the Mountain Plains Consortium University Transportation Center (University of Utah)
- PL - Pooled Fund projects
- TB - Test Bed: projects initiated as part of the I-15 National Test Bed
- TT - Technology Transfer project
- UT - UTRAC: A project generated through the UTRAC process
- XF - Experimental Features project

YY = Year the project was generated, in two digits

XXX = A numerical, sequential code, restarting at "001" for each category each year (except in the case of "UT" projects, as described below).

UTRAC projects ("UT") use a special format for the three-digit, sequential project code. The first digit represents the UTRAC Group which initiated the project, and the remaining two digits are a sequential number assigned as the project is introduced to the UTRAC Group. The UTRAC Groups are as follows:

0	Group 10:	Engineering Technology
1	Group 1:	Construction
2	Group 2:	Maintenance
3	Group 3:	Materials and Pavements
4	Group 4:	Environmental
5	Group 5:	Planning and Asset Management
6	Group 6:	Traffic Operations and Safety
7	Group 7:	Geotechnical

8	Group 8:	Structures
9	Group 9:	Hydraulics

PIC numbers for UTRAC projects follow the same numbering scheme as the Problem Statements, but use a slightly different format, as shown below:

UTRAC Problem Statement No: 07.05.04 becomes PIC UT07.504

Examples of PIC numbers are given below to clarify their construction and use:

AM07.003: A project initiated at the request of the UDOT Administration in Fiscal Year 2007. This was the third "administrative" project initiated that year.

MP08.001: A project initiated due to some miscellaneous need or request in Fiscal Year 2008. This was the first project of the "miscellaneous" type during that year.

UT07.504: A UTRAC project initiated at the 2007 Workshop in Group 5 (Planning). This was the fourth project introduced in that group that year.

UT06.802: A UTRAC project initiated at the 2006 Workshop in Group 8 (Structures). This was the second project introduced in that group that year.

PIC numbers are used exclusively by the Research Division for internal tracking and monitoring. They should be placed on contracts, invoice payments, formal correspondence, and other documents tied to the project. PIC numbers are sometimes referred to by entities outside the Division, but are not tied to broader UDOT or FHWA databases or lists. They do not change over the life of the project as many other codes or designators do.

3.5 Project Type Selection

The PM with oversight from the TAC should select the type of project that best meets the needs of the end-users. The available funding levels and needed deliverables should be considered. Options for project type are as follows:

1-	Research Project	(Section 1.3.1)
2-	Topic Synthesis	(Section 1.3.2)
3-	State-of-the-Practice Study	(Section 1.3.2)
4-	Experimental Feature	(Section 6.2)
5-	Demonstration Project	(Section 6.1.13)
6-	Pooled-Fund Project	(Section 4.2.5)
7-	Submitted to NCHRP for funding	(Section 2.9.2)

3.5 Outreach Partnerships

It is often necessary to create partnerships with other agencies, universities, or private sector entities to acquire the resources needed to conduct the project.

A- Pooled-Fund Projects: Topics of national or regional interest should be considered as pooled-fund projects. Projects with very high costs should also be candidates for pooled-fund projects to reduce the outlay by any one agency.

B- UTC Matching Funds: If it is determined that one of the UTCs in the state has the expertise to conduct the project, consideration should be given to using the UTC matching funds.

C- NCHRP submittals: Issues facing the national transportation industry may be submitted to the NCHRP for voting. Again projects with very high costs are candidates for NCHRP funding.

D- Private Sector Resources: Expertise, materials, products, equipment, laboratory testing, manpower, and other resources may be donated or acquired at a reduced rate for the project.

3.6 Contract Preparation and Documents

Once the work plan and scope of work are prepared and approved, a research contract is prepared for any project done outside of UDOT. Standard contract documents are used for this process. These documents are included in Appendix D of this manual.

Ten steps are required during the contract preparation and processing:

1. The Scope of Work developed by the PI, the PM, and the TAC is assembled in the general format outlined in Attachment C to the contract.

2. A contract cover sheet is prepared showing the project title, organization performing the work, contract amount, contract start and end dates, and other pertinent information.

3. The Project Manager selects the appropriate version of Attachment A (Standard Terms and Conditions) and edits the Attachment B document (Special Terms and Conditions) to suit the specific needs of the project.

4. The PIC Number and the project funding phase number, assigned by the Research Program Manager, are placed on the Contract Cover sheet (at the bottom) and on the Attachment C title page.

5. The Research PM assembles three originals of the contract document package by including:
   Cover sheet
   Attachment A
   Attachment B

Attachment C

These original contract documents are sent to the PI's Contracting Officer for signature.

6. The PI's Contracting Officer signs the contract documents and sends them back to the Research PM.

7. The Research PM attaches an internal routing slip and routes three originals to both the Research Director and Director of Project Development. After these internal signatures have been obtained the contract document is considered fully executed and legally binding.

8. After obtaining internal signatures the Research PM sends three original contract documents to the UDOT Comptrollers office for processing. The Comptrollers office logs three original contract documents into their database, assigns a contract number, and distributes:

   One executed contract document to PI's Contracting Officer
   One executed contract document to Research Technician

   The Comptrollers office keeps one executed contract document for their files.

9. The Research Technician scans the contract document, sends an electronic copy to the Research PM and the Research Program Manager, logs contract information into the "active projects" spreadsheet, creates a new file folder, and files the original contract document in the Contracts File.

10. The Research PM sends a Notice to Proceed to the PI and the PI's Contracting Officer.

3.7 Detailed Work Plans

A project's research effort is defined in its work plan. The work plan must describe the approach intended, and specify how the study will carry out the tasks needed to meet the project outcomes. A concerted effort in preparing work plans is required to obtain focused objectives, improved research, and a high potential for implementation of the project results. Detailed objectives save resources and time. Well-planned research maintains credibility in the performance of the research team and their results. The potential for implementation sustains interest, enthusiasm, and a desire to induce change within the Department.

When a sole-source method is used the Principal Investigator (PI) should be a key player in the preparation of the Work Plan. The PI should utilize the Problem Statement, the preliminary project budget, the information compiled during the literature search, and comments from the TAC members. A good Work Plan contains the following as a minimum:

3.7.1 Project Title

The title for the project should be short but descriptive enough that anyone scanning a list of titles will not be misled.

3.7.2 Statement of Problem

It is necessary to give a complete description of the problem and its effects on the operations of the Department. An explanation of the inadequacy of a technique, material, or specification can define the extent of the problem.

3.7.3 Problem Background

The conditions that currently exist must be defined and all known research on the issue summarized. A history of the condition provides knowledge and important background for the development of the work plan and its successful completion.

3.7.4 Questionnaires and Surveys

The use of questionnaires and surveys are a very effective and efficient way to compile information on a research topic. This is an excellent way to gather data and opinions from experts from Utah, around the country, and those in other countries. Meaningful information can only be acquired by following standard protocol for surveys and questionnaires:

3.7.4.A Survey Preparation
The questions included in the survey must be complete and accurately stated to capture the desired information. Both direct and open-ended questions should be included. Space should be provided for the respondent to add comments on any of the questions of the topic in general.

3.7.4.B Population Selection
Often the target respondents for the survey can be very wide in scope and the researcher can welcome any response from any source. Web delivered surveys work well in this situation. If the number of experts in the field is too large to cover a sample of the individuals in the expert group must be carefully selected.

3.7.4.C Pretest Survey
When possible a pretest should be employed to obtain feedback and comments on the survey content. A small test group, usually internal, can help the researcher to fine-tune the survey. In addition to written comments the researcher should look for problem areas in the survey. These may be answers left blank, ambiguous answers, questions yielding no useful information, or answers based on obvious misinterpretations.

3.7.4.D Survey Distribution and Follow-up
The final survey may be delivered in many forms: hard copy, email, web site surveys, etc. The most appropriate format(s) should be selected based on the population and location of the

respondents. Responding to the survey should also be flexible. If possible the survey response may be mailed, emailed, faxed, or any other method convenient to the respondent.

A reasonable deadline should be established that allows time for busy experts to schedule time to respond without encouraging procrastination. A few days after the deadline, a follow-up request should be sent to non-respondents.

3.7.5 Study Objectives

The objectives define the conditions that are expected to exist at the completion of the work. These conditions are described by goals that give the optimum technique, material, or specification from a financial, operational, environmental, and/or social viewpoint.

3.7.6 Project Tasks

The project tasks demonstrate an understanding of the techniques and methods to be used to resolve the problem. The list of tasks must contain all components necessary for the successful completion of the research, including updating the state-of-the-art, design of the research experiment, laboratory testing, computer facilities, data collection elements and procedures, analytical processes, notation of key decision points, schedule of meetings, and reporting details.

Test section installation, field data gathering techniques, and laboratory testing plans must meet good technical and statistical requirements. More detail on these issues are described in Sections 6.2.5 and 6.2.6.

3.7.7 Schedule

A detailed schedule of the project timeline is required. The period of time when each task will be addressed is needed to properly manage the project progress. The schedule will include both calendar date when the task will be accomplished, and staff hours estimated per task. Milestones and decision points are also shown.

3.7.8 Implementation Statement/Project Benefits

The processes used to implement the research will be outlined. Because of the potential for change in the research strategy, detailed definition of the implementation process is not given in the work plan but must be updated as the project progresses. The expected qualitative benefits of successful research should be stated.

3.7.9 Champions

Every major project undertaken by the Research Division must have a dedicated champion of the issue. This has been shown over many years and by many organizations to have a significant impact on the chance for successful completion and implementation of the project results.

Projects without valid champions often fail to deliver usable products and in many cases fall short of the wide spread acceptance needed within the organization. For this reason the project manager and research administrators should take the time and effort to ensure that an appropriate champion is located and is willing to commit to the tasks needed for a successful project.

The project champion should be knowledgeable about the technical aspects of the topic, have an understanding of the scope of the undertaking within the industry, and be a key stakeholder in the success of the project. The main role of the champion is to dedicate the time and resources needed to help the PI and PM toward the successful completion and use of the initiative.

3.7.10 Project Manager

The project manager is selected from the Research Staff and assigned to the project. The duties of the project manager make him the central contact point for all project activities.

Ideally the project manager is the same individual that was assigned to evaluate the Problem Statement during the UTRAC process. This is not always practical but does create a "cradle to grave" management perspective to the initiative. On rare occasions the project manager may be an FHWA staff member, a hired consultant with special skills, or a UDOT expert from another division or a region office.

3.7.11 Technical Advisory Committee (TAC)

Guidance and oversight from an experienced TAC is very important for a research project to reach a successful conclusion. Input is provided related to tasks that are to be completed during the study. This input is useful to the principal investigator, the project manager, and other TAC members that are asked to provide data, testing, specific knowledge, and/or other information related to the project. Open and detailed discussions about how the information should be gathered, processed, and reported are essential.

The Technical Advisory Committee (TAC) is entrusted with the following duties:

1- Work with the principal investigator, research staff, project champion, and key stakeholders to develop the project work plan. This includes the project scope, objectives, tasks, budget, and implementation.
2- Assess the technical status of the project by reviewing reports and holding discussions with project staff at meetings.
3- Evaluate overall project progress.
4- Advise project staff on an individual project basis.
5- Provide oversight on the implementation of the project deliverables.

The TAC membership should have a wide range in expertise related to the topic being studied as well as how to provide oversight on research initiatives. Committee membership is drawn from the following:

- Research Division staff,
- Operating units of the Department most affected by the results,
- FHWA officials,

- Non-Department organizations with expertise in the area of research

The Research Director appoints a staff member of the Research Division as the chairperson of the committee. The Research Division makes arrangements for TAC meetings. Meetings are held as needed.

3.7.12 Principal Investigator (PI)

The principal investigator selected to conduct the project must demonstrate a complete knowledge of the issue to be studied, and the skills needed to conduct the project as outlined in the Detailed Work Plan.

The TAC can choose to sole-source the project to a Principal Investigator (PI) or they may elect to advertise the project by distributing a Request for Qualifications (RFQ). Typically RFQs are used when the project cost is very large, the project scope is very controversial, or when no known experts are available. Sole-source contracts are generally used when the project is of low cost, or an expert has submitted the idea and may have intellectual property rights for the concept.

3.7.13 Project Team Membership and Requirements

It is important to identify a knowledgeable Principal Investigator (PI) and any other staffing requirements needed to carry out the tasks listed in the work plan. Also included are the time commitments by task for each significant expert.

The work plan may contain detail about how the TAC members, champions, and the project manager will interact and participate in the project. Any specific assignments concerning supplying data, completing laboratory testing, or other key elements of the project should be outlined.

When appropriate, material suppliers or construction contractors are also included in the work plan preparation and may become members of the TAC. The success of the research and the implementation of the results may depend on construction techniques and the availability of materials before specifications are developed.

3.7.14 Budget and Payment Schedule

A detailed budget is required that outlines the manpower, testing, materials, or other resources needed, and the cost of each task within the project.

The work plan describes how invoices will be submitted and paid during the project. Typically invoices are paid following the submittal of major deliverables or other milestones.

3.8 Project Budget Preparation and Approval

The development of an accurate budget for the project is obviously very important. A preliminary estimate is required in the Problem Statement form, but is often only a rough estimate based on the limited scope prepared for project selection. It is usually an iterative process where manpower requirements for each of the tasks listed in the Detailed Work Plan is estimated.

The Principal Investigator, the Champion, the Project Manager, and the TAC conduct a review of the estimate for each task. Consensus should be reached where possible on a reasonable budget for the project. Each component of the work plan represents estimates of salary, equipment, travel, and miscellaneous costs. For example, components show the following:

- Wages for investigators, technicians, and support staff;
- Fringe, administrative, and indirect charges;
- Equipment needs;
- Travel costs;
- Miscellaneous expenses; and
- Subcontractor costs (itemized above).

3.9 Monitoring Project Progress

Ultimately the Project Manager is responsible to monitor the progress of projects that are assigned to him. He should coordinate on a regular basis with the Principal Investigator, TAC members, champions, Research Division administrators, and end-users of the deliverables.

Monitoring the project progress should be done in a formal, professional manor that ensures that each aspect of the work is progressing as planned. This helps to address problems early and to make necessary changes to the project plan in a timely manner.

3.9.1 TAC Meetings and Management Oversight

Regular TAC meetings are a must to keep all stakeholders of the project up to date on the progress and to get constant feedback to the PI on project issues. TAC meetings should be scheduled when a key milestone of the project is reached. This may be when a deliverable is ready for evaluation, or when a data set is completed for review.

Typically a cluster of meetings is held early in the project to finalize the scope of work. A target of one meeting each quarter is recommended during the project, but some meetings may be delayed if no new information is available. Another group of meetings typically are required near the end of the project to review and comment of deliverables, and finalize the implementation strategy. These summary meetings must address the implementation strategy for the project deliverables. The continued responsibility of the PI, project manager, and key stakeholders is defined.

Minutes of all meetings should be prepared and distributed. Most work plans call for the PI to take minutes and distribute them to the TAC, PM, champions, and Research Division Director.

3.9.2 Milestones of the Project

Key milestones of the project should be established in the work plan to aid in monitoring progress. These may be test section completion, data gathering targets, information analysis summaries, or the submittal of formal project deliverables. Accountability should be required for the PI and any UDOT expert providing information or project resources.

3.9.3 Deliverables

The quality and timeliness of the project deliverables are the most important aspect when monitoring the project. The satisfaction of the TAC, champions, and end-users should be measured. A complete review of the deliverables should be conducted and comments addressed. All stakeholders should complete an "Exit Survey" for the project. (See Section 8)

3.9.4 Invoices

The processing of invoices is typically linked to the submittal of project deliverables or other key milestones. A significant amount of the project budget must be held until the final deliverables are submitted and approved.

3.10 Project Deliverables

3.10.1 Final Reports

A final report is a requirement of all major research activities. The standard contract documents (schedules B and C) have specific wording about what final reports should include. Format requirements for reports are provided in "Guidelines for Preparing UDOT Research Reports" (Report UT07.10). Research reports are assigned a publication number by the Research Division, and hard copies are placed in the Lester Wire Library and other locations as required by federal guidelines. Electronic copies are posted on the Research web site.

3.10.2 Interim Reports

In many instances interim reports are used to disseminate information to the end users, champion, project manager, and stakeholders in a timely manner. This aids in decisions related to the continuation of the project, evaluation of the research methods, and allows for the early implementation of any key findings.

3.10.3 Executive Summaries

Executive summaries are a very valuable way of communicating the project findings and deliverables to key UDOT managers, technical experts, policy makers such as State Legislators, and administrators in other agencies.

These summaries should be written carefully for the intended customer. The technical level of expertise needed to understand the issue, the study findings, and the project recommendations must be considered. More than one Executive Summary may be needed. Broad topics may be of interest to the layperson, key UDOT leaders, and technical experts alike.

3.10.4 Presentations

Many different mediums can be used to present research findings. Presentations are an important product of a research project. They serve many purposes including educating stakeholders on the issue, seeking consensus on the findings, developing support for the recommendations, and facilitating implementation strategies.

In general presentations should be formal and professional and serve as a deliverable of the project. UDOT should own the presentation and receive final copies for multiple applications. Copies may be distributed to interested parties, posted on the research web site, or archived for future use.

3.10.5 Policies

Policy research has been shown to be a valuable part of the transportation research agenda. The Research Division has a key role in responding when the existing policies are outdated or invalid. Policies that are based on sound engineering judgment and applicable, unbiased technical information are the foundation of UDOT's programs.

3.10.6 Specifications, Special Provisions, Processes and Procedures

Whenever possible the development of new or revised specifications, special provisions, technical processes, and operational procedures should be required in the project Scope of Work and contract. These deliverables are crucial to the continual improvement of UDOT's design, construction, and maintenance operations.

Obviously the research staff must work closely with the end user of the product to instill a sense of ownership in the new development. Care should be taken to involve these key personnel throughout the process by involving them on TACs and other groups.

3.10.7 User's Manuals and Training Sessions

The publication of user's manuals is a critical step in implementing certain research deliverables. In conjunction with a professional training session the user's manual is a resource to the customer and to his replacement when turnover occurs.

User's manuals should be required to contain a complete description of how to use all aspects of the new development. The Research Division will assign a report number for the manual, maintain copies in the UDOT Library, and post electronic version on the web site.

3.10.8 Software Packages and Web Sites

Many research deliverables are in the form of software and/or web sites. Software and web development requires coordination with UDOT Information Services Division. The research deliverables must adhere to all UDOT and State standards. Requirements are available from the Information Services Division as a published document upon request. These requirements change due to new software versions and functionality.

Software packages when required in the contract must be developed in formats that can be supported by UDOT systems and hardware. There are situations where UDOT does not own the code, but retains the rights to use software developed under the contract at "no cost". All software and web sites must comply with standards that can be protected by firewalls and other tools when necessary.

The Information Services Division should have a representative on the TAC when software and/or web sites are to be deliverables of the project. This facilitates the use of proper development tools and environments by the PI when creating these products.

3.10.9 Test Results and Ownership

Quite often project data and information is in itself a product of a research initiative. This information may be valuable in future efforts concerning the topic studied. New approaches to previously studied topics are common. It is important to maintain this information in a usable format for future needs.

Electronic formats are obviously a must for data archiving processes. The submittal of basic data, and the format in which it will be transmitted, should be addressed in the Scope of Work. When appropriate the use of hard copy information in an appendix in the final report, or in the form of a Volume 2 publication should be considered.

UDOT has ownership of all data and information acquired during a research project. Any sensitive data or information cannot be released to any parties without the submittal of a formal Grama Request to the appropriate UDOT officials.

3.10.10 Publication Rights

The Principal Investigator, report authors, or others seeking to utilize any research data while the project is "active" must receive written approval from Research Division managers. This includes any papers or newsletter articles published prior to publication of the UDOT final report. UDOT employees performing research must coordinate publication of all materials with the Research Manager and the Department press liaison.

3.10.11 Patents and Copyrights

Research results may include innovations that are eligible for patents or copyrights. The Research Division follows the FHWA and Department standard policies for patents and copyrights. Provisions detailing ownership rights are included in all research contracts. PIs and other consultants are encouraged to seek patents since they may lead to spin-off companies and benefit the economic development of the State. The Department always retains the non-exclusive, no-cost right to the patented or copyright items.

Products and concepts developed by UDOT employees including the Research Division staff are also eligible for patents or copyrights. All Department personnel involved in research activities should be notified of the policies and laws relating to these products.

3.11 Project Level Implementation Issues

The ultimate goal of every research project is the implementation of the findings and deliverables. The implementation objective is so important that each phase of the project should be connected and interrelated to the implementation phase.

In many instances the implementation of project products can be incorporated into UDOT operations prior to the completion of the study. A more detailed discussion of implementation processes and tools is provided in Section 7.

3.12 Research Project Evaluation

3.12.1 Purpose

Projects are evaluated throughout the course of the research effort, as described in Section 8. In addition, after the research is completed and project deliverables are implemented, a final project evaluation is performed. Final evaluations are performed to assess the value of the research to the Department, to learn what was done well, and to determine improvements for future research efforts.

Evaluations can provide benefits to the Department that may result in cost savings, improved processes or methods, safety improvements, and improved or increased information for management decision-making and policy formulation. Cost savings and safety improvements can be quantified. Improved methods or information can be documented by qualitative means.

3.12.2 Process

3.12.2.A Process Internal to Department

The Research Division performs final project evaluations. Depending on the complexity of the project, each project is reviewed and research performance and research results are analyzed.

When possible interviews and surveys are conducted on users of the research results, the researcher, and others involved in the research process. For each major project TAC members, champions, and end-users of the deliverables will complete an "Exit Survey" form (Appendix B).

3.12.2.B Process External to Department

The project may be evaluated by others outside of the Department at the discretion of the Research Division, the Project Committee, or the Research Advisory Committee. The evaluation may be performed through contract, by organizations affected by the research, or by research peers in other agencies. External project reviews concentrate on research methodology validity, data collection and analysis, and research results.

3.12.2.C Economic and Quantitative Process

To measure research project performance and benefit, economic and other quantitative analyses of varying sophistication are performed according to project size and available data. These analyses include:

- Net savings of dollars,
- Time and lives,
- Cost-to-savings comparisons,
- Cost-benefit,
- Present value,
- Return on investment.

3.12.2.D Qualitative Process

Qualitative evaluation of the performance and the results of the research project provide valuable information. For research project results, qualitative evaluations focus on the following:

- Conformance to expected performance of the product, process, or method;
- Ease of application of the product, process, or method; and
- Qualitative improvement in operation, function, or management information.
- Adherence to appropriate research methods,
- Timeliness of the effort,
- Technical excellence,
- Fulfilling the scope of the effort, and
- Performance within budget.

3.12.3 Project Documentation

Upon completion of the research project the Project Manager is responsible to document all the project activities by archiving the products developed during the project. This is far more than the formal deliverables required in the work plan and contract.

A detailed file should be maintained on the project in the Research Division. The following should be archived in the project study file:

- Problem Statement
- Work Plan/Scope of Work
- Signed Contract for the Project
- Literature Search
- Literature Review
- TAC Minutes and Correspondence
- All Stakeholder Correspondence
- Questionnaire and Survey Results and Originals
- Field Test Results and Section Information
- Laboratory Test Results and Analysis
- Progress Reports
- Interim and Final Reports
- Copies of Deliverables
- Exit Surveys and summaries

SECTION 4- WORK PROGRAM DOCUMENT AND APPROVAL

4.1 Work Program Overview

The Research Division prepares and publishes an "Annual Work Program" to document important aspects of the Research mission and to assign resources to each initiative. The Work Program serves two basic functions:

1- The Annual Report informs our partners and customers about progress being made on all significant research activities. It outlines the program for transportation research at UDOT during a given federal and state fiscal year for research projects, syntheses, special projects, experimental features, new products program, technology transfer programs, and major implementation initiatives.

2- The Work Program meets federal and state requirements documenting the appropriate use of research funding. Federal regulation mandates that the states certify the proper use of these SPR funds and appropriately manage them. Chapter 23 of the Code of Federal Regulations (CFR), Section 420, requires states to develop, establish, and implement a management process that identifies and implements research, development and technology transfer activities to address priority transportation issues, including the development of an annual work program. The elements of the program must be documented to ensure effective use of the funds. The Work Program also contains the required Certification of Compliance and an FHWA approval letter, as required in 23 CFR, Parts 420 Subpart B and 511.

4.1.1 Categories of Research

The categories of research performed within the transportation environment fall into two areas: basic research and applied research. Basic research involves the study of phenomena whose specific application has not been identified; the primary purpose of this kind of research is to increase knowledge. Applied research involves the study of phenomena relating to a specific, known need in connection with the functional characteristics of a system; the primary purpose of this kind of research is to answer a question, solve a problem, or make operations more efficient.

In general, the Research Division programs are applied research; depending on the academic and private sectors to conduct the basic research needed. Although the public sector environment makes it very difficult to perform anything other than applied research, efforts should be made to reserve some research funding to perform basic research initiatives.

4.1.2 Programming Proposed Initiatives

Prior to receiving funding a research proposal must receive approval for inclusion into the Annual Work Program either through the UTRAC process or by an administrative mandate. In addition to the initiation of new projects, the Annual Work Program allocates funding and authority for the various programs carried out each year in the Research Division.

4.2 Program Deliverables

The results of the programs funded in the Annual Work Program should be summarized each year. The results of these programs are usually delivered by:

- Number of literature searches conducted
- Number of syntheses published
- New products evaluated
- Workshops sponsored
- Demonstration projects conducted
- Experimental features initiated and completed

A line item is developed for each funding category on each of the major programs in the Research Division. A brief description of the program is provided, what products are planned, and the funding level appropriated by fiscal year.

4.3 Program Balance

On an annual basis managers in the Research Division should evaluate the balance in the various programs funded in the division. It is very important to maintain a constant degree of support and commitment to key UDOT managers and each of the customer bases that the division serves. When the Annual Work Program becomes out of balance in any way, steps should be taken to expand effort in the areas with less allocated resources.

4.3.1 Factors Contributing to Program Balance

The following factors should be considered when evaluating where the overall research budget is allocated in the Annual Work Program:

4.3.1.A Important Assets and Pressing Issues for UDOT
Maintaining balance in the Research and Development Program does not necessarily mean that each customer base should receive an equal share of the research resources. Some transportation goals and functional areas have more of a need to innovate than others at any given time. This changes over time as the pressing issues of the Department change.

Another issue related to program balance is the overall importance a customer's needs carries to the discussion. Big-ticket items such as pavements, bridges, culverts, traffic control devices, construction management, and materials should be well funded since the potential pay back from research activities is so much greater. Also any issue having a direct impact on safety is a good candidate for higher levels of funding and manpower. Feedback from the Department's

Asset Management experts is an excellent way to determine what the appropriate dedicated resources should be for each area.

4.3.1.B Available Division and Region Resources

In addition to this shifting customer need, is the ability of other divisions and region groups to contribute to innovative enhancements with their own resources. An example of this is the Planning Division, which uses a portion of the SPR funding to conduct studies and improve their activities. ITS personnel also have dedicated funding to do studies and install advanced equipment. Conversely many divisions and units have very little funding to make the needed improvements, and may need more resources from the research programs.

4.3.2 Balance Related to UDOT Strategic Goals

The most straightforward approach to evaluate the research program balance is to compare the various projects and programs within the division with the Department's Strategic Goals. The discussion in Section 2.1 provides a good foundation for evaluating the program balance related to the Final Four.

Funding, manpower, and other resources should be dedicated to each of the short and long-range goals of the Department. A breakdown of each of the major research initiatives into one of the Final Four allows research managers to review the current commitment of resources and make adjustments in the future.

4.3.3 Resource Allocation by Functional Areas

Another effective way to review the research program balance is to observe the functional areas of the transportation field. These are the same focus areas utilized in the UTRAC process as follows:

- Construction
- Engineering Technology
- Environmental
- Geotechnical
- Hydraulics
- ITS & Traffic and Safety
- Maintenance
- Materials & Pavements
- Planning & Asset Mgt
- Structural

Each functional area should be reviewed to determine the number of projects or initiatives conducted in that area, and the total level of funding dedicated to the area. The following table is an example of how this analysis has been traditionally summarized.

Research Program Balance

Functional Area	Number of Projects	Percent of Funding
➢ **Structures**	**13**	**28%**
➢ **Geotechnical**	**8**	**16%**
➢ **ITS/Traffic and Safety**	**9**	**14%**
➢ **Construction**	**4**	**6%**
➢ **Maintenance**	**5**	**11%**
➢ **Materials/Pavements**	**4**	**8%**
➢ **Hydraulics**	**3**	**6%**
➢ **Environmental**	**3**	**5%**
➢ **Planning/Asset Management**	**4**	**6%**
Totals	**53**	**100%**

4.3.4 Research Initiative Types

Another way to evaluate the balance of transportation research projects and ventures can be categorized into research types as follows:

1- Hard Research
2- Soft Research
3- Policy Research

Hard research activities such as construction, materials, maintenance, etc. are typically high cost aspects of the transportation business. Research benefits achieved in this research type can have very high payback and cost-effective improvements.

Soft research, related to design, environmental issues, could be very technically challenging resulting in a significant need for innovative solutions to problems. Many of these enhancements are in the form of automating and standardizing operations.

Policy research typically can be undertaken with modest funding levels, but often provides high levels of improvements and unique enhancements. Adding new policies where needed, improving existing policies, and eliminating counter-productive policies can have a profound impact on the transportation community in Utah.

4.3.5 Engineering Solutions vs Political Decisions

In any governmental entity politics must be balanced with the recommendations of the agency's experts. Decisions made based on political judgment or hard data alone may not always be the best course of action. Too often projects, programs, and policies made without considering both philosophies do not result in the most effective or efficient initiatives.

All undertakings of the Research Division should consider both hard data and non-engineering factors when possible. Further, it is the responsibility of the Research Division to encourage UDOT managers and technical experts in other divisions and the regions to gather all of the necessary facts prior to proceeding with the decision-making process. There are methods that can be used to avoid errors and less desirable choices by UDOT personnel.

Care should be taken to select committee membership that represents the full scope of the experts needed to understand all aspects of the initiatives produced. Diversity on UDOT's committees and task forces is critical to good decision-making practices.

A well-organized peer review process should be in place for all major decisions made in the Department. This would include design issues, management initiatives for all major transportation assets, safety programs, and major policy decisions just to name a few. A good example of peer review is the Value Engineering program.

Putting appropriate policies and procedures in place to foster good decision-making is an important aspect of our business model. Making sure these rules are followed is just as crucial. Oversight and performance measures mandated by program managers often are conducted in an inconsistent manner. In previous decades the FHWA provided most of UDOT's oversight in this area. The FHWA oversight has been diminished, leaving UDOT to take the lead on this important function. Every effort should be made to make sure that a quality product is delivered to the traveling public in the most cost effective and efficient manner possible.

UDOT political and managerial personnel should be educated about the importance of the New Products Program and how it works. When vendors circumvent the program, it usually means that the product cannot meet the rigid standards established for new products.

Appendix F contains examples where both good and poor political decisions that were made by key managers based on recommendations from the Research Division.

SECTION 5- FUNDING SOURCES

Funding for research efforts at UDOT is provided by various federal, state, and public sources. These funds are used as direct funding, matching funds, or in combination to achieve research goals and responsibilities.

The primary sources of funding are the State Planning and Research Program (SPR) and the State Construction and Administration funds. Other federal funding is made available through programs like the Innovative Bridge program, the I-15 National Test Bed special appropriation from Congress, other state funds allocated by the Department, funds from other states assembled in the Pooled Fund system, and matching funds through the University Transportation Center program or private sources.

5.1 State Planning and Research (SPR)

For many years, the federal government has supported transportation research at the state level though the allocation of State Planning and Research (SPR) funds. Federal law (US Code Title 23, Section 505) stipulates that two percent of the transportation funds apportioned to the states in a given year be used for research and planning activities. This amount is the SPR fund. The Code further defines that at least 25% of the SPR funding be used specifically for "research, development, and technology transfer activities" related to transportation. Further, federal regulation mandates that the states certify the proper use of these SPR funds and appropriately manage them. This allocation of federal funding provides the significant financial base for the Research Division activities at UDOT.

5.2 Special Federal Funding

In addition to the SPR allocation, other federal funds available for research efforts at UDOT during fiscal year 2008 include Innovative Bridge funds, Highways for Life funds and the remaining funds from the I-15 National Test Bed.

Innovative Bridge funds are typically awarded each year to individual projects deemed meritorious by the FHWA. Over the past several years, UDOT has been awarded annual amounts on the order of $0.5 million for specific bridge projects where innovations are proposed. Given the long lead time involved in some of these projects, and the delay in funding awards, several of these Innovative Bridge projects are still open and have unspent, but budgeted, funding.

During the late 1990's, UDOT embarked on an unprecedented reconstruction of the I-15 corridor in Salt Lake County. The $1.4 billion, 16.5-mile urban design-build project was the largest of it's kind in the United States, and presented a unique research opportunity. With 142 bridge structures slated for demolition and replacement, UDOT and its research partners developed a research program aimed primarily at the full-scale testing of bridges and

foundations. Thirty-one research projects were identified for funding, and $4.7 million was obtained to fund those projects. The largest share of that funding package was a special congressional appropriation, through the TEA-21 funding bill, of $3.8 million, including a 20% state match. The I-15 National Test Bed program was executed in four phases. Although the reconstruction project is long since completed, a few of the research projects are still underway, and a portion of the Phase IV allocation is still available to help fund those projects.

5.3 Special Federal Matching Funds

In order to foster transportation research at the nation's universities, and to encourage cooperation between these universities and the state Departments of Transportation, the U.S. Department of Transportation has instituted a University Transportation Centers (UTC) program, administered by the Research and Innovative Technology Administration (RITA). With funding and direction from the newest federal transportation funding bill, "2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users" (SAFETEA-LU), the Mountain Plains Consortium (MPC) regional UTC has received renewed funding, and Utah State University has been designated as a Tier II UTC.

The MPC UTC is a consortium of 10 universities, centered at North Dakota State University. The Traffic Lab of the University of Utah Civil and Environmental Engineering Department, in Salt Lake City, is a participant in the MPC, and receives funding to be used as matching money on research projects. The new Tier II UTC at Utah State University, in Logan, Utah, also receives money to be used as matching funds for transportation research projects. The UDOT Research Division has been a beneficiary of both of these UTC matching fund programs in recent years.

5.4 State Funds

UDOT provides state funds, from the State Administrative and State Construction budgets to help support research efforts. State funding comprises the second largest portion of the Research Division revenue budget. State Construction funds are typically used to match federal funds in the research program. State Administrative funds are usually allocated directly to research projects.

5.5 Pooled Funds

Projects are sometimes initiated as a joint effort by the FHWA and several states. The entities pool their resources to pursue research efforts of common interest. This Pooled-Fund program is administered by the FHWA. Each agency that commits to a given project contributes a portion of the funding for that project, from their SPR or other funding sources. In cases where UDOT is the state leading a given research project, funds from the other participating states may show up as revenue to the project, depending on how the funds for that specific project are administered and spent.

SECTION 6- DEVELOPMENT PROGRAM

The UDOT Divisions and Regions benefit significantly from the Development Program. The personnel and resources dedicated to this program support the Technology Transfer, Implementation, Experimental Features, Demonstration Projects, and New Products activities.

The goals and mission of these units is to not only to aid with evaluating and implementing findings of in-house programs, but also to adopt worthy technologies developed elsewhere. This includes advancements by other governmental agencies, innovative concepts from universities in other states, and improved technologies from the private sector. This is an overwhelming task and well-educated and dedicated personnel are required to achieve these goals.

This program is very wide in scope and interacts with virtually every aspect of transportation in Utah. For this reason the customers and stakeholders of this program are as follows:

1- Division managers
2- Region technical experts
3- Policy makers
4- Designers
5- Research project managers
6- FHWA personnel
7- University professionals
8- Product vendors
9- Contractors
10- Consultants
11- Metropolitan Planning Organizations (MPOs)
12- Industry and trade groups

Care must be taken to avoid doing development work without compensation that is the responsibility of the private sector, university personnel, or other agencies. There is a great deal of gray area in the conduct of development tasks. The laws written to avoid expenditures of public funds outside of intended programs are valid, but many worthy initiatives may not be developed without some support from research organizations. Help should be given to vendors and inventors in the form of providing contact information to agencies that can provide research funding.

6.1 Technology Transfer

Technology Transfer (T^2) is the exchange of information and knowledge acquired through research and leading to the adoption of a new-to-the-user product or procedure by any users. Technology transfer includes research results implementation and product or process deployment. Activities leading to the adoption of innovations can include the transfer of knowledge, education and training, presentations, showcases, communications and marketing

efforts, and technical assistance. In addition, in this transportation context, technology transfer includes the complex process of change dealing with technical issues.

6.1.1 Technology Transfer Activities

The main goal of conducting applied research is to improve or enhance transportation practice. In order for research results to be used, a transfer of knowledge from researchers or other transportation professional experienced in the use of a technology must be made to the new/potential user. Technology transfer activities are broadly defined and the type and level of activity depend on the technology itself. In addition, the processes, methods, and products involved in the Department's technology transfer activities are so diverse that several mechanisms are used to promote the most effective transfer process.

Technology transfer occurs within and outside the Department. Most frequently, the Department selects applicable innovations from research results performed with the Department research funds. The process encompasses the dissemination of applicable research results and knowledge regarding new processes, methods, and products within the Department and the transportation community as a whole.

Technology transfer activities also involve technology scanning—selecting applicable innovations from research results or other new processes, methods, and products available outside the Department. These innovations come from within the transportation community or related technical fields elsewhere. The broad reach of the Department assists in attracting the best and most appropriate technologies for application to its practice. The Department's technology transfer activities include use of innovations and sharing the most beneficial with others.

The Department conducts or participates in a variety of activities under the technology transfer umbrella. Routine dissemination of research reports, quarterly newsletters, electronic transportation news, literature searches, white papers, web based sessions, peer – exchange videoconferencing, library presentations and other actions inform transportation peers of the Department. Other technology transfer activities are performed as required. Demonstrations and workshops, information brochures, and other special media, as well as technical assistance and implementation-friendly packaging are some of the activities used.

The UDOT Research Division is actively hosting transportation related web-based conferences or webinars from TRB, FHWA, NHI, ASCE, and ITE and other sources. All webinars that are free of cost are held based on their availability.

AASHTO's Technology Implementation Group (TIG) has been an important technology transfer program for UDOT. The Research Division is involved in proposing ready to implement technologies to TIG on annual basis. Each year TIG selects a highly valuable process, procedure, software, device, or other innovation that has been adopted by at least one agency. The innovation must be market ready and available for use by other interested agencies.

The FHWA Priority Technologies and Innovations program has been beneficial to UDOT experts. The UDOT Research Division is actively involved with the implementation and deployment of the FHWA Market Ready Technologies. Annually UDOT reports back to the FHWA on the status of the deployment of these technologies.

The Technology Transfer program strives to keep UDOT employees equipped with the best methods and technologies necessary to make appropriate transportation decisions for the needs of the growing public. Researchers, engineers and practitioners often need information that may already exist, either in documented form or as undocumented experience and practice. This information may be in many forms such as fragmented, scattered, and unevaluated.

Sometimes knowledge on a subject may not be published. As a result costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the pressing problems. Technology Transfer methods may be crucial in documenting and transferring this information.

6.1.2 Technology Transfer Customers

Everyone benefits from the transportation system, and hence, from transportation research. The immediate beneficiaries of research and technology transfer are UDOT, its employees and other transportation agencies and users. The research technology transfer should be for the immediate customer, with the larger community in mind.

6.1.3 Technology Transfer Partners

The partners of research are also the beneficiaries of research. The partnerships formed with UDOT operating units, universities, companies, transit authorities, consultants, local governments, regional agencies, FHWA and the public will require constant renewing. The transfer of technology cannot be accomplished without the concurrence and assistance of these partners.

6.1.4 Technology Transfer Products

A concise knowledge of the customers, partners, and activities involved with the T^2 activities are important to the Research Division. T^2 is an activity that is conducted on a daily basis. All methods of collecting and disseminating information on transportation improvements are pursued to foster implementation and to avail Research Division partners of staff expertise and keep the transportation community apprised of the latest advances in the field.

6.1.5 Benefits of Technology Transfer

Technology transfer benefits to the Department are numerous, but the most significant advantage is that the Department's transportation problems are solved in a more cost-effective and timely manner. Technology transfer promotes innovation within the Department and eases the adoption of innovations within the transportation community at large.

Technology transfer provides substantive technical information by providing technologies shown by others to be appropriate for the Department. In such cases, scarce funds are not wasted on duplicative research and development. Instead, they are spent efficiently on field-tested processes, methods, or products. Technology transfer resulting from FHWA, state, and collaborative relationships with the AASHTO member departments is reviewed for relevance to the Department. Sound practices and innovative technologies are shared with county- and municipal-level agencies within the state. The transfer of effective processes, methods, and products increases the technical quality and ability of the whole state to better provide transportation services to its citizens.

Technology transfer also brings state-of-the-art innovations necessary to sustain quality service for the public into the Department. Only through contact with other transportation professionals, researchers, manufacturers, and organizations does the Department learn about appropriate innovations to better meet its mission and objectives.

6.1.6 Information Resources

Many information resources are available to foster technology transfer within the Department. The most commonly used resources are publications and other media from other State DOTs, FHWA, OCLC, TRB, AASHTO, and colleagues within these organizations. Manufacturers, vendors, and other research communities also offer a great deal of information regarding innovative processes, methods, and products. Because international transportation information is easily obtainable, technology transfer is global in scope.

6.1.7 UDOT Lester Wire Library

The UDOT Lester Wire library is providing services to all Department employees, researchers, and others contracted by the Department. The library offers walk-in lending services and electronic search capabilities for many national databases.

The library is an information resource and storage house for reports, publications, and standard references covering all aspects of transportation related research, current and past. The literature maintained in the library is available on loan to all divisions and the regions in UDOT. Files are also maintained on research studies, experimental features, new products, and major implementation actions conducted by the Research Division.

The library's primary effort is to transfer technical information to Department employees, including the following:

- Maintaining, handling and archiving records
- Daily mail delivery
- Interlibrary loans
- Scanning
- Preparing monthly library new acquisitions list
- Cataloging publications
- Holding monthly library technology transfer sessions or web conferencing

- Displays: special technical displays highlighting new research in specific topical areas
- Literature searches

6.1.8 Transportation Research Information Service (TRIS)

6.1.8.A Purpose of TRIS

The basis of research support is timely information. Despite the expertise of the staff, there are many informational requests made of research that require literature searches. An analysis of problem statements and informational requests must consider the literature defining the state of the art of the subject. The Transportation Research Information Service (TRIS) is one of the most comprehensive files of literature on all subjects in the field of transportation. As each project is completed, the Technology Transfer Engineer ensures the final report (and any other reports as appropriate) is cataloged in TRIS.

TRIS is a primary technology transfer source for the Department. The TRIS Online database contains over half a million records of published transportation research including technical reports, books, conference proceedings and journal articles. Currently there are almost 24,000 TRIS records with links to electronic copies of the full-text.

TRIS is a source for information retrieval and information dissemination. The Research Division searches the database for the Department. In addition, the Research Division also submits data regarding Department research efforts to TRIS.

The tasks for which TRIS is most frequently used are as follows:

- Literature scans and searches to determine state of the art,
- General scans and searches for technical reference supporting Department operations,
- Dissemination of information about the Department's research projects (in-progress status and project results).

6.1.8.B Reporting To TRIS

Completed research projects will be reported to the Transportation Research Information Services (TRIS) database after the research is published. The report includes at least abstract, author's name, publication date and the link to the full report from the UDOT's Research Division website.

6.1.8.C Key wording

A search of a computerized file for information on a subject starts with a selection of the appropriate key words. If the keywords are too broad in scope, too much information will be returned; it will be very time consuming to siphon that which is important to the search. Conversely, if the keywords are too specific, very limited information may be returned.

A selection of keywords should be made after discussing the subject with the client. Only then can the search structure be properly set up. It's important to structure the search so that the information available to the user adequately covers the subject.

6.1.9 Research in Progress (RIP) Database

The RIP database has information on ongoing or active research projects. RIP is a comprehensive national online database on all ongoing research subjects in the field of transportation. As each new research project is funded and initiated, the Technology Transfer Engineer, an authorized user, enters project information into this database. The reporting will include the abstract, start and finish dates, project manager/investigator names and the performing/ sponsoring agencies contact information.

6.1.10 Other Resources

There are many other resources that the Research Division uses for technology transfer, including face-to-face or some other personal contact with professional colleagues, technical literature, as well as other technical materials and sources.

Several technology transfer activities in which the Research Division may participate include the following:

- AASHTO committees and subcommittees, including the Research Advisory Committee, the National Transportation Product Evaluation Program (NTPEP), SHRP implementation committees, and NCHRP panels;
- TRB technical committees and the TRB annual meetings;
- American Society for Testing and Materials technical committees;
- National Institute of Standards and Technology activities;
- Highway Innovative Technical Evaluation Center technical committees;
- Industry associations and professional societies;
- FHWA regional and national technical panels and committees;
- Electronic access to literature via computer (Internet's World Wide Web); and
- Technical publications (e.g., journals, periodicals, and other literature).

All organizations listed above also provide literature, research results, or other materials to assist in the technology transfer process.

6.1.11 Marketing Techniques

The Research Division makes every effort to promote effective use of research results by the Department and others. In addition, the unit is committed to encouraging the consideration of promising technologies used by others and applicable to Department operations.

6.1.11.A Marketing Strategies
The Research Division understands that users of innovations (research results or other applicable new technologies) are research program customers. The Research Division uses various marketing strategies regularly to foster technology transfer as follows:

- Product assessments: critique of technologies for potential Department use;

- Market/user assessments: determination of operational areas that could best profit from early adoption of new technology, priorities for continuing the adoption by users, and fostering of champions within the Department user units;
- Enhanced communications: focused packaging of research results tailored to the users' needs; continued communications with users to determine problems;
- Resources analysis: staff, facilities, and funding required to transfer the technology; and
- Barriers and boosters analysis: identification of technology barriers so as to capitalize on situations that ease the transfer of the technology.

6.1.11.B Media Marketing

The involvement of the media can be a very useful way to promote research products and educate virtually every customer base on new transportation concepts. Whenever research is newsworthy resources should be dedicated to preparing a package for release to the media.

The Media Marketing program at UDOT has been a formal undertaking at times and very informal at others. There are many advantages of having a group of experts assigned to this issue, holding regular meetings, and prepare materials for release. Most media outlets are looking for topics to cover on slow news days. This is very beneficial to both UDOT and the public.

Packages released to the media should have the following attributes:

- Information should be in layman's terms.
- Interesting facts should be included
- How the innovation saves money, time, or improves safety
- Future intended use by the industry

6.1.12 Demonstration Projects

When appropriate, the Research Division sponsors and promotes demonstrations, showcases exhibits, and other field or operational presentations of technologies that could benefit the Department. In general, demonstration technologies originate with FHWA, AASHTO, and industry.

Once the Research Division determines that an organization is willing to perform a field demonstration of new technology, it solicits interest from within the Department. The Research Division may coordinate the demonstration or assist the applicable Department technical unit. The new technology is introduced to as many Department personnel as possible. Government officials, academia, researchers, consultants, and contractors often are invited to attend, when appropriate.

6.1.13 Technical Assistance

Research Division staff provide consulting services on an as-needed basis to other operational units within the Department. Requests for such services are made through the Research Division manager. The services provided are of relatively short duration and generally involve problems requiring an immediate solution. The Research Division places a high priority on these requests

and is committed to providing quality responses as soon as possible. A brief letter report of findings and or recommendations is provided to the operating group.

6.1.14 Local Technical Assistance Program (LTAP)

This FHWA program was established to encourage cost-effective improvements to roads and bridges owned and maintained by local governments. Federal aid is available for 50 percent of the program funding. The State and the Utah State University match the funds.

Through technology transfer, training courses, users' manuals, on-site demonstrations, and a strong network of technical expertise available to the local governments, the program has successfully furthered implementation of highway innovations at the local level.

- Organization or university administering the program,
- Funding amounts and sources of matching funds,
- Length of time in operation,
- Staffing,
- General services provided/technical activities,
- Detailed “customer” list, and
- Program benefits.

6.1.15 Technology Scanning

The Department must be informed about the most recent technological developments in transportation. Research Division staff are committed to scanning information in the various transportation and related technical fields to determine the applicability of innovations. Active efforts are made to be informed about domestic and international transportation technical advancements.

Literature is scanned for promising technologies. The Research Division requests materials about various technologies and disseminates them to applicable Department staff. If there is sufficient interest in the technology, the Research Division will organize a presentation or an informal forum with individuals knowledgeable about the technology or will use some other method to inform Department staff about the technology.

The Research Division will contact professional colleagues having experience with the technology to further determine practicality for the Department and to determine if field (or in-place) observation of the technology can be made by Department staff. As a result of technology scanning, the Research Division staff also will take the appropriate actions to test, further research or develop, or encourage application of new technologies selected by the Department's Research Advisory Committee.

6.1.16 Success of Technology Transfer and Implementation Efforts

The UDOT Research Division will conduct an annual evaluation of the research program to measure the success of the technology transfer and implementation efforts. The evaluation

consists of an internal review and feedback from others in the Department who participated in or was the beneficiaries of technology transfer and implementation.

6.1.16.A Internal Review

An internal review of the Research Division's technology transfer and implementation activities is performed annually. This internal review is the Research Division's assessment of the technology transfer and implementation activities during the past year. Internal review determines successful strategies that can be duplicated and recommends improvements for the others.

Internal review asks the following:

- What were the most important accomplishments in technology transfer and implementation?
- Were the technology transfer and implementation goals met for the period, and, if not, why?
- Did the participation in technology transfer activities from Department personnel meet expectations, and, if not, why?
- Was an implementation plan done for all projects? (If not, how can these be done in the future?)
- Were the individual project implementation goals accomplished, and if not, why?
- Were sufficient funding and staff available for the technology transfer and implementation? (If not, how can this be remedied in the next period?)
- What barriers to technology transfer and implementation were encountered during the period, and how can they be overcome in the future?
- What assisted technology transfer and implementation activities during this period, and can these be augmented to make the program even more effective?

6.1.16.B User Feedback

Because technology users are those most affected by the technology transfer and implementation activities, the Research Division solicits their opinions regularly. A written survey is conducted periodically to determine user perception regarding the Research Division's technology transfer and implementation activities and to suggest improvements.

Users are chosen from the group of Department staff and others associated with technology transfer and implementation activities performed during the period.
The user survey asks about the following:

- The degree of usefulness of the technology transfer and implementation activities,
- The most (and least) helpful activities performed by the Research Division during technology transfer and implementation efforts,
- How technology transfer and implementation efforts with and without the Research Division's involvement compare (What difference was there in having the Research Division involved?),
- Perception of the effectiveness of the technology transfer or implementation activities (Was the technology transferred, was implementation accomplished?),
- The enhancements or eliminations to the process, and

- General comments regarding the research and technology program.

The benefit of having a research program is best measured in terms of the successful transfer of technology. The research staff determines if technology is transferred by assessing users of the research. A survey of the beneficiaries of the research should highlight the efforts of the research program.

6.1.17 Research Publications

Research Division research reports are made available in both online and printed copies. The bibliography in the appendix also lists publications relevant to technical transportation topics and management. The Research Division retains most of the publications in its office.

- Transportation Research Board—TRB Records, dealing with transportation research management issues; TRNews, quarterly publication of TRB; and TRB Special Reports and Syntheses of Practice Reports (all NCHRP items are listed in the annual TRB Publications Catalog).
- Public Roads Magazine—Published by FHWA. Periodically includes program management articles.
- Research-Technology Management Magazine—Published by the Industrial Research Institute, Washington, DC. This is a very good source of general research management information. Primarily supported by private sector organizations. Most material is directly applicable to public sector research activities.
- Research and Technology Transporter—Newsletter published by FHWA Turner-Fairbanks Highway Research Center. Occasional program management articles, mostly technical.
- Harvard Business Review and Harvard University Press—Has general management materials.
- Journal of Management in Engineering—Published by American Society of Civil Engineers. Includes some articles of relevance to general program management.
- Journal of the Technology Transfer Society—Published by the Technology Transfer Society, Indianapolis, Indiana.
- R&D Innovator—Newsletter.
- Department management training materials.

6.1.18 Research Newsletter

The UDOT Research Division Newsletter is a quarterly publication to provide current information on the Division's research activities. The newsletter is available in PDF format from the research division website. Articles from other divisions could be included in the Newsletter.

6.2 Experimental Features

The Experimental Features Program enables the Department to conduct field or laboratory evaluations of new or innovative transportation products. Any feature, procedure or product that is relatively new and for which no UDOT standard defines its qualities may be used in a construction project or other field location as an experimental feature. An Experimental Feature can vary dramatically in complexity. They can require a high level of sophistication in experimental design, instrumentation, measurements, and testing, or they may be much more simple depending on the nature of the particular feature and information needed.

Experimental features in Utah are generally funded through the FHWA Experimental Projects Program. These projects are defined by the law as "a material, process, method, equipment item, traffic operational device, or other feature that: (1) has not been sufficiently tested under actual service conditions to merit acceptance without reservation in normal highway construction, or (2) has been accepted but needs to be compared with alternative acceptable features for determining their relative merits and cost effectiveness.

6.2.1 Experimental Feature Principal Investigator, Champion and Supplier

The success of an Experimental Feature relies heavily on project oversight both in the Research Division and by the end users of the feature. It also rests on the support provided by the supplier of the product under study. A Principal Investigator for the project will be assigned from the Research Division staff, and a champion will be assigned to represent the end users of the project deliverables. The supplier is typically the vendor or owner of the product. The supplier can be very useful in making sure the design is adequate, the installation meets standards, and can deliver the product for analysis at a reduced cost.

The project champion is a crucial member of the project team. The Department requires, as stated in "Policy for the Evaluation of New Products and Processes", that all experimental features have a champion. The champion could be a squad leader, resident engineer, materials engineer, pavement management engineer, or other responsible person related to the project. The champion's role is to be the lead user of the product, and guide the evaluation. If the evaluation shows promising results, the champion would play a key role in the implementation of the results.

6.2.2 Work Plans

Field trials of the products of research are important and demanding because these trials are generally performed under normal traffic conditions and with a variety of environmental settings. A good work plan is essential to ensure that the project is adequately funded, coordinated, and that good deliverables result from the project.

The champion may request that a Technical Advisory Committee (TAC) be formed to assist in guiding the test. In cooperation with the TAC the Product Evaluation Engineer or other assigned PI completes the Experimental Feature Work Plan. The work plan is submitted to the

Region Director for review and approval. Funding for experimental features is available through a line item included in the SPR Annual Work Program.

The work plan of an Experimental Feature should contain the following:

1- Names, titles and addresses of the Principal Investigator, champion, sponsor, vendor, Development Engineer, and any other key personnel.
2- The project objectives describing the purpose, intended product uses, implementation approach, and expected economic benefits.
3- Reference to any supporting literature or information.
4- Tasks to be carried out to meet the objectives.
5- Method of construction.
6- Materials to be utilized.
7- Control sections if required.
8- Estimate of the costs of each project phase, including costs for materials, construction, equipment, and any other significant aspect. Unit costs should be used where possible for comparison with traditional features.
9- Estimated time needed to complete each phase.

If the product is proprietary and is being incorporated into a federally funded construction project, the process will conform to the FHWA guidelines pursuant to 23 CFR 635.411 and shown at the following web site:
http://www.fhwa.dot.gov/programadmin/contracts/expermnt.cfm.

The work plan must be organized such that the findings will be gathered and reported even if the feature or product does not perform as designed. Too often end users of new concepts do not follow through with the reporting phase of an Experimental Feature that is not successful. Negative findings can be very valuable to make sure the concept in its current form is not adopted. Diligent reporting can also be useful to future endeavourers by documenting the flaws in the concept. Innovative aspects of transportation systems often require more than one attempt before a useable version is developed.

6.2.3 Experimental Features Design

As the work plan is being developed, the design of the field test should be based on one of the following four types: true experimental, quasi-experimental, non-experimental, or historical. The Product Evaluation Engineer should be trained in each of these types.

6.2.3.A True experimental design training examines the feasibility of assigning subjects to at least two groups (i.e. experiment and control) and discusses their designs.

6.2.3.B Quasi-experimental design training examines the reasons that true experimental design is not possible and discusses time series and other designs.

6.2.3.C Non-experimental design examines the reasons that an experimental variable cannot be introduced and discusses correlation procedures.

6.2.3.D Historical design examines the environment that exists to require an historical design and discusses sources of data for the design.

6.2.4 Installation of Experimental Features

The methods used for the installation of Experimental Features are similar to those in a research project. The Development Engineer is responsible to ensure that the installation conforms to accepted principles for experimental projects which includes the following:

- The lengths of the test sections must adequate to properly evaluate the feature
- A proper number of replicates must be installed to eliminate conditions such as the geometrics of the section, randomness of the test site, differential traffic, etc
- Control sections of standard design are installed for comparison
- Selecting a site that is representative of future use of the feature

Experimental Features that are to be evaluated within a construction project should be incorporated into the process as early as possible. It is desirable to include them in the location or preliminary design phases of the project development, although they can be added in later phases, even during project construction.

It is important to incorporate Experimental Features on projects where the performance will be representative of actual field conditions. This will lead to optimum results at minimal costs. These test sections provide valuable information by identifying and often solving problems before full-scale application under normal highway operations.

When the product is installed, all conditions affecting the work plan should be documented and included in the report. As the test progresses, the Product Evaluation Engineer notifies the TAC of the following circumstances:

- Failure or difficulty in the test
- Unexpected or unexplained results or findings
- Change in direction
- Uncertainties about activities or project direction

6.2.5 Laboratory Testing and Analysis

Carefully planned laboratory testing is the foundation of many transportation research projects. Laboratory tests can evaluate products for specification compliance, reveal the makeup of products and materials, and simulate the performance of the product under operational conditions.

The development of new specifications and special provisions is one of the fundamental goals of research. Test results that are accurate, precise, and repeatable are a must for this type of research project to be successful.

Laboratory test procedures, technician certification programs, and equipment verification techniques should be conducted on a routine basis to ensure that quality tests are conducted.

These verification processes are generally the responsibility of the UDOT Materials and Tests Division. Outside laboratories should be required to verify the accuracy of their testing procedures and equipment through acceptable certification methods.

Blind testing is used on occasion to test one sample set within more than one laboratory. Sampling plans to ensure a consistent set of test specimens should be used. Once a uniform sample set is available, random sample sets are sent to various laboratories. Independent locations are used such as some combination of the UDOT Central Laboratory, Region Office Laboratories, University Laboratories, and FHWA facilities such as the Turner-Fairbanks Highway Research Center. The test results are very useful in developing the confidence needed to recommend specifications that industry as well as government officials can depend upon.

The laboratory testing and analysis plan for any project must be documented in the Detailed Work Plan. This will ensure that the required information will be acquired, the data will be analyzed as planned, and the project will remain within schedule and budget.

6.2.6 Test Sections and Field Testing

The Principal Investigator, Project Manager, and TAC members are responsible as a team to ensure that the installation conforms to accepted test section principles. The placement of test sections should be described in detail in the Work Plan and include the following:

- Test section lengths must be adequate to properly evaluate the material, design, construction process, or other factors in the project.
- A proper number of replicates should be installed to eliminate conditions such as the geometrics of the section, randomness of the test site, differential traffic, etc
- Control sections of standard design should be installed for comparison
- The test site should be representative of future use of the product.

When the product is installed, all conditions affecting the work plan should be documented and included in a Construction Report and the Final Report. As the project progresses, the PI should keep the TAC members informed on any problems such as:

- Failure or difficulty in the test section or evaluation processes
- Unexpected or unexplained results or findings
- Outside influences such as changes in traffic loading, environmental modifications, and unexpected routine maintenance.

6.2.7 Data Collection and Analysis

The data collection method should be according to the work plan. The work plan should be carefully developed and address the appropriate conditions, equipment, frequency, time intervals and analysis techniques.

Errors in the data can occur at any step of the process. Care must be taken to ensure that the data collection conditions and equipment are thoroughly checked at all steps in the process.

The basic concepts of descriptive and inferential statistics should be understood and applied to the analysis of the data. The choice of the appropriate statistical test is based on several factors. In particular, familiarity with the chi-square test, the t-test, the one-way analysis of variance, and the Pearson product-moment correlation, are desired.

6.2.8 Presenting and Reporting Results

Experimental features require formal documentation. This requires reporting as follows:

- Construction report
- Field survey notes
- Performance documentation
- Final report

The best writing skills available should be employed. The report is the main means by which peers become acquainted with the research. Ambiguity must be minimized, and information must be conveyed easily and clearly.

As the product is evaluated according to the Work Plan, an Interim Report is prepared in conjunction with the data collection schedule, and posted to the Product Evaluation Database. The Interim Report includes the information from the Work Plan, the Construction Report and the data that has been collected to date. When the evaluation is complete the Final Report is prepared and posted to the Product Evaluation Web Site. UDOT internal and external customers will be notified via email when the reports are posted.

During the study, individuals or groups may ask for preliminary results or finding. All presentations of preliminary research must receive approval by champion and TAC. The decision on presentations should be a joint effort by the TAC. Graphic displays are encouraged.

6.2.9 Implementation of Experimental Features

When the final report is published the Product Evaluation Engineer will meet with the UDOT champion to assess the potential for implementation of the product. Guidance for implementation strategies may be found in "Optimizing the Dissemination and Implementation of Research Results", Transportation Circular No. E-C070, found at the following web site: http://onlinepubs.trb.org/Onlinepubs/circulars/ec070.pdf.

Of specific interest in the consideration of implementation strategies, is the potential for a new specification or a change to an existing specification. The Product Evaluation should work closely with the UDOT champion to consider how the knowledge gained from the test could be addressed in a specification.

6.2.10 Deliverables and Products

The development of a new specification is considered to be the most valuable product of an Experimental Feature. Care must be taken to find an optimal compromise between specifying the most useful product while still allowing for competition to keep bids at an acceptable level.

Enhancements to an existing specification may be proposed based on the findings of an Experimental Features evaluation. Special provisions may be drafted using the data gathered on the project.

The test sections, laboratory test results or other pertinent information can be used in themselves as a deliverables to UDOT personnel, the champion, or experts in other states.

6.2.11 Maintaining Records

Well-ordered project records should be maintained. The credibility of the research depends on the ability to organize and retrieve documents. Upon completion of the Experimental Feature the Development Engineer is responsible to document all the project activities by archiving the products developed during the project.

A detailed file should be maintained on the project in the Research Division. The following should be archived in the project study file:

- Work Plan/Scope of Work
- Signed Contract for the Project
- Literature Search
- Meeting Minutes and Correspondence
- Field Test Results and Section Information
- Laboratory Test Results and Analysis
- Progress Reports
- Interim and Final Reports
- Copies of Deliverables

6.2.12 Termination of an Experimental Feature

The progress of an Experimental Feature should be monitored on a routine basis. The project may be terminated early if it can be shown that the continuation will result in an inferior or unacceptable product, or if further evaluation will not result in additional information. The Principal Investigator will obtain approval from the sponsor, champion, and Research Director before termination of the feature.

6.3 New Product Evaluation

The Research Division acts as the new product evaluation clearinghouse for the Department. Vendors desiring to market their products have an established process to use. Department decision-makers have a process and database in place to document all product evaluation activities. The process will not engage in the evaluation of any new product unless it has been

adequately developed, tested, and marketable. It is crucial for the New Product process to be objective, impartial, and efficient when evaluating these products.

If it is desired that a product be tested in the laboratory or in the field, the Research Division provides the process and personnel to track, evaluate and report on the results of the evaluation. A field test can be set up and evaluated as an Experimental Feature.

A New Product is evaluated and classified according to its recommended use. Engineering related products only are eligible for the program. These include products primarily used in the construction, maintenance, and operation of transportation programs involving highways, bridges, and other transportation facilities. Products that are related to data processing, architectural, and equipment purchasing and maintenance will not be considered under these procedures.

6.3.1 Product Evaluation Process

The main purpose of the New Product evaluation is to document the vendor's claims regarding the new product, determine if the product has potential use for the Department, and, if the product is set up as an experimental feature, test the product under local conditions to determine if it will perform as marketed. The New Product process consists of the following basic steps:

1- Information acquisition and initial screening.
2- Preliminary examination.
3- Detailed evaluation (laboratory and field if necessary).
4- Prepare documentation and detailed product file.
5- Develop or modify any appropriate specification, special provision, procedure, drawing, or standard.
6- Conduct implementation activities.

6.3.1.A Product Information

A key component of the product evaluation process is the capturing of all salient product information from the vendor. The vendor requesting a product evaluation is asked to complete and submit the "Preliminary Information for Product Evaluation Form" which is shown in Attachment B1.

6.3.1.B Review and Database Input

Upon receipt of the completed "Preliminary Information for Product Evaluation Form " from the vendor a PE file number is assigned to the form and the information is entered in the Product Evaluation Database.

6.3.1.C New Product Evaluation Panel

The New Product Evaluation Panel (NPEP) meets monthly to process the vendor applications. Rotating NPEP members are selected by area of expertise from UDOT regions and divisions and serve on the panel for two years. Permanent panel members are selected by position.

When the panel lacks knowledge to make a decision on a product, an expert from the Department is invited to the meeting. The panel listing is shown in Attachment B7.

The NPEP will make their preliminary evaluation of each new product by considering the following questions:

1- Does the product have a potential beneficial use for the Department?
2- Do the identified uses justify a detailed evaluation?
3- Has the product been adequately developed and tested by the vendor or other agency?
4- Is there sufficient evidence to support the claims made for the product?
5- What is the relative cost of the product?
6- Are there other products available at less cost that will perform the same function?
7- What level of effort will be required to adequately evaluate the product?
8- Should a test section be installed considering the cost, potential problems, and specialized equipment needed for installation?

6.3.1.D Product Classification Notification

The NPEP reviews all "Preliminary Information for Product Evaluation Form" submissions from the vendors and categorizes each product into one of two categories:

- Product has potential use for the Department
- Product has no anticipated potential use for the Department

6.3.1.E Review Period and Database Input

The NPEP decisions are documented and posted to the UDOT inner web for a 30-day review period with an email notifying relevant UDOT divisions of the posting. Any comments received during the review period are reviewed and addressed as needed prior to the vendor notification. If no comments are received, the product vendors are notified of the panel's decision and the decisions of the panel are entered into the Product Evaluation Database.

6.3.1.F Product Information Time Limit

Product postings will remain in the Product Evaluation Database for a period of four years from the original posting date. At the end of five years, the vendors will be notified they need to resubmit the "Preliminary Form for Product Evaluation" for each product they desire to be evaluated.

6.3.2 Deliverables and Products

The most valuable product of a new product evaluation is when a new standard is written and submitted for adoption. A team effort should be employed to develop any new specification, special provision, procedure, drawing, or standard. Existing specifications may be modified based on the results of a new product evaluation. Special provisions may be drafted using the data gathered on a new product. Care must be taken to find an optimal compromise between specifying the most useful product while still allowing for competition to keep bids at an acceptable level.

Another key product of the New Product process is the record logged into the Product Evaluation database. The record shows the "Preliminary Form for Product Evaluation" with all pertinent attachments and the NPEP decision as to the products usefulness to the Department.

The test sections, laboratory test results, or other pertinent information can be used in themselves as a deliverables to UDOT personnel, the new product vendor, or experts in other states.

6.3.3 Implementation and Feedback

It is crucial to follow through on the adoption of these deliverables by the appropriate committees or program managers. Successful implementation is the key measure of any Research Program. Care must be taken to avoid the appearance that UDOT is endorsing the use of a specific product by referring to it by name in a standard.

The approval of a particular product is not a guarantee of general use. Once accepted by the Department the vendor is responsible to promote and market the product to potential users.

A process should be engaged to provide a feedback loop on the implementation of standards developed through the New Products program. Each standard adopted should be evaluated six to twelve months after adoption to determine if some flaw in the process reversed the successful implementation. The new product evaluation may need to be reactivated to analyze and resolve these problems.

6.3.4 Funding for the New Product Program

The successful operation of the New Products Program requires adequate resources in the form of personnel and funding. Department funds are dedicated as part of the Annual Work Program. These funds are eligible for use in the following areas:

1- Limited funding for product installation. Generally costs are to be the responsibility of the vendor. Where larger installations are required the use of an Experimental Feature should be considered.
2- Purchase of additional quantities of the new product beyond that which the vendor can reasonably be expected to donate for evaluation.
3- Purchase of specialized equipment needed to install or evaluate the product.
4- Costs of incidental activities required for installation of certain new products, such as traffic control, rental equipment, etc.

SECTION 7- IMPLEMENTATION PROGRAM

One of the most crucial, but often less successful programs in transportation agencies is the implementation of new and innovative concepts. This is usually not from a lack of effort but due to the great number of barriers to the implementation of new methods. Typically implementation efforts require commitment, funding, manpower, planning, technical adjustments, and completion of the feedback loop through performance measures. Many implementation initiatives require training, equipment purchases, new policies, specification changes, and formal procedural modifications.

Barriers related to the human factor in engineering should not be ignored or underestimated. Managers in technical disciplines resist changes in operations due to a perception of too much risk, poor understanding of the benefits of new concepts, and a basic ownership of the traditional way of doing business.

These issues are not trivial and dealing with them cannot be routinely handed off to personnel who are inexperienced or have not been part of the original research. The implementation of an innovation must be planned as much as possible early in the project, even during the problem statement phase. How the deliverables will be implemented (or if they can be) should be considered when making the decision to fund the project initially. If the barriers to implementation are too great, the funding agency should consider delaying or canceling the project until these issues are resolved. A commitment from key leaders may be necessary prior to undertaking the project to mandate acceptance of some new concepts if the project is successful.

Implementation activities, although difficult, can be the most rewarding part of the research process. The implementation plan is the framework for everyone's involvement. Good project monitoring ensures that the research is geared toward implementation. Ultimately successful implementation demonstrates the benefits of the Research Division to the Department.

The chance for the successful implementation of research deliverables can be improved by taking several key steps before, during, and after the conduct of the project. The following sections outline these steps and identify potential roles of end users to enhance the chance for successful adoption of research deliverables and findings.

7.1 Implementation Program Functions

Six basis functions comprise the implementation effort as follows:

1- Identification: It is important to identify concepts, solutions, and methods that may upgrade or improve current practices. Sources for these innovative ideas may result from completed in-house research, results from experimental features, new product evaluations, or from a number of sources outside of the Department.

2- Planning: Resources should be allocated to developing a plan to successfully implement a new idea or concept.
3- Promotion: An array of techniques is available to advertise a process, market its benefits, and encourage its use.
4- Packaging: An implementation package consists of all of the needed information for adoption in a format that is useful to the end user.
5- Adoption: The process of gaining approval by the appropriate committee to adopt a standard, specification, policy, or procedure.
6- Evaluation: The process of validating that the concept is viable, and that the projected cost-effectiveness has been met through field or applied use.

7.2 Problem Statement Implementation Plan

During concept development the problem statement must include information related to the processes and potential for implementing the project findings. The following questions must be successfully answered before the project is funded:

1. What implementable deliverables will be created?
2. How will the findings be implemented?
3. Who will be the key personnel in the implementation phase?
4. What funding level will be needed for implementation?
5. What if the expected funding source?
6. Will training be needed?
7. What are the implementation risks, barriers, and strategies to overcome them?
8. What are the specific benefits of the project products?

7.3 Scope of Work and Contract Related Implementation

The typical research initiative begins with the customer's question or problem and provides an answer. This is not always conducive to the implementation aspect of the research. A more successful approach entails addressing the customer's issue through a Scope-of-Work that helps him answer his own question. This approach fosters the type of ownership in each phase of the research that naturally leads to more complete implementation.

The Scope-of-Work should not only describe how the project would be conducted, but it should answer each of the questions above in detail about how the findings will be incorporated into UDOT practice. Commitments from personnel should be obtained, and a plan drafted to achieve a useable technology, standard, or policy. Funding for implementation tasks may be included in the original contract, or conceived as part of activities in a phase 2 plan. The higher the chance for a successful project, the more likely the funding will be included as part of one contract.

7.4 Implementable Deliverables

As projects near completion or are close to producing results, the Research Division evaluates them for applicability to Department practice. In conjunction with potential users and the TAC, the Research Division updates the implementation plan to ensure effective and timely application of the research results throughout the Department. Implementation activities, methods, and events required by the numerous technologies with which the Department deals are broad and flexible.

Too often the TAC or sponsoring agency fails to require the proper deliverables needed to facilitate implementation of the research findings. A final report alone is often insufficient in providing the needed tools for implementation. The following deliverables should be considered in addition to a final report as part of the contract to aid decision-makers and end users to get the innovative aspect into practice:

- User's Manual
- Training Sessions & Materials
- Policy & Procedures
- Specifications
- Software
- Workshops & Demonstrations
- Web page
- Executive Summary
- Experimental Feature
- Demonstration Projects
- Laboratory Testing
- Performance Measures

Funding for implementation activities may come from the Research Division's SPR Program, from State Research funding, or provided by the end users. A budget line item is included in the Annual Work Program for implementation of research, when a large-scale effort is anticipated. This line item reserves funds for the testing, adaptation, packaging, and promotion of new technology. If other implementation resources are required (e.g. facilities, staff, or other items), they are described in detail in the line item description. Commitments for these funds should be obtained prior to application of the technology.

7.4.1 Reports, Newsletters and Research Briefs

Reporting the findings of research is an obvious step required in the implementation process. This is important not only to the agency conducting the research, but to those from other agencies. It is crucial to report negative findings as well as successful research. Too often researchers undertake a nonproductive project because an agency that has performed a similar study is unwilling to publicize unsuccessful work.

All written deliverables should address the implementation tasks required, who is responsible complete these tasks, and how the work will be funded. A complete implementation plan is a very important step in the process.

At some point (six to twelve months after completion) the project manager should employ a feedback loop to verify that no barriers to implementation have occurred. These problems should be addressed in a timely manner. Unfortunately many valuable

technologies have been abandoned due to some very minor problem that could have been easily corrected. Communication with end-users over a period of time is sometimes needed to remove obstacles and make minor improvements.

7.4.2 Training Initiatives

A good working relationship with training personnel in the Department is very important. The training program is a valuable asset to the implementation effort. Funding and manpower can be utilized from the training budget to enhance the effectiveness of the implementation program.

The project Principal Investigator, the champion, the Project Manager, or some combination of these experts could conduct the training. Occasionally an outside technical expert may be employed to train users on the technology. User's manuals are professional, complete, and accurate are usually required for end-users to assimilate the technology over time.

7.4.3 Specifications & Standards

The adoption of sound specifications and standards is an important method used to augment the application of research results. These measures do not always insure the adoption of the technology, however. It is important to convey the reasons why the change has been made through training, reporting, or other methods. Staff members often find ways around specifications, such as the use of special provisions, if they are not convinced that the change is appropriate. A routine telephone or E-mail survey should be scheduled many months after the specification is adopted to ensure that it is still being used.

It is important for all stakeholders in the process to have input into writing, endorsing, and supporting the new or modified specification. The impact of a new specification or standard can be significant on a broad scope of entities and personnel in the Department. Quite often a designer must accurately incorporate the standard into the plans, a contractor must be able to construct the modified project, and maintenance forces must be able to maintain the asset over time. Examples of these assets are paving materials, regulatory signs, pavement markings, and many safety features on a project just to name a few.

7.5 Technical Advisory Committee (TAC) Role in Implementation

Each project must have a functioning TAC to provide oversight to the performing organization personnel and aid the project manager. These advisors are crucial to the success of the project. The TAC members should be made up of primarily end-users of the project deliverables, and should be selected with implementation of the study findings in mind. This promotes commitment very early in the project and fosters an environment of ownership by the users. This also brings implementation issues into the planning phase of the study. The practical aspects of the work will be emphasized, more useful products can be proposed, and funding can be allocated for tasks aiding the customers.

If the project addresses the decentralized aspects of UDOT's operations, each of the four regions should be represented on the TAC. If the issue is intended for a central set of users, stakeholders from multiple divisions may have representation on the TAC. Care should be given to ensure that all divisions, sections and region personnel who will be impacted are represented and informed on the project.

Secondary impacts can sometimes be overlooked. For example, if a new safety device is recommended in the project, and Traffic & Safety Division agrees with the findings, the Maintenance Division should have input into the decision. Maintenance personnel must be able to install the device if it is damaged or worn out. They will be required to have replacement parts in their inventory for the device.

Most TAC membership should include a representative from the Federal Highway Administration (FHWA). This will help the TAC avoid conflicts during the project with federal rules and guidelines. Further where federal rules are no longer appropriate, the project can be useful in changing or helping to get UDOT exemptions from federal requirements. The FHWA staff member can be very beneficial in facilitating these actions.

Progress reviews by the TAC are crucial to keep the work on track, and steer the effort toward practical findings. A thorough review of the end products is important to enhance the implementation effort. Much of the implementation will be immediate since the users are involved throughout the study. Also, they will have a better understanding of the technology, and more buy-in is achieved due to the ownership generated through the TAC. An "Exit Survey" of TAC members is important to obtain feedback into the process, as well as the value of the research project.

7.6 Implementation by Special UDOT Committees

The implementation of new concepts can be initiated, planned, and carried out by various committees such as the Standards, Materials, Maintenance, etc. Items for implementation may be generated in-house or may be topics distributed by other agencies around the country.

The various UDOT committees are encouraged when appropriate to take the lead in the adoption of the issue, but the Research Division should always maintain a role in the process. Research resources are available to transportation personnel in Utah for the purpose of facilitating implementation activities of many types.

7.7 Monitoring Implementation Activities

All research projects are monitored to ensure appropriate research performance as well as to maintain adherence to appropriate research methods (see Section 4.8, Project Conduct and Management). Research projects also are monitored to determine the appropriateness of the implementation planning. Significant mid-project changes may alter ultimate

implementation actions. If change occurs, preliminary implementation planning is updated accordingly.

Implementation activities are tracked by the end users, project champion, project manager, and other members of the TAC. Monitoring includes reviewing the description of steps given in the implementation plan. The project manager prepares brief progress reports for review by the TAC and research managers.

The implementation process is evaluated according to the details of the implementation plan. Evaluation occurs after an appropriate period of time so that the effectiveness of the implementation can be measured. The time frame and milestones for evaluation are included in the implementation documentation. Questions considered include the following:

- Is the process, method, or product performing as anticipated? If yes, how? If not, why?
- Are user needs being met as anticipated? If yes, how? If not, why?
- Is the innovation being implemented throughout the Department? If not, why? (Which significant barriers were overcome and which must be addressed?)
- Have benefits and objectives been achieved or is there an indication that they will be met? If yes, what benefits exist and to what extent?
- Are costs of implementation as anticipated? If not, why?
- Has the anticipated implementation schedule been met? If not, why?
- What improvements to the innovation should be made, if any?
- What additional actions to broaden the implementation of the innovation will be taken?

7.8 Facilitating the Implementation of Research Results

Many activities assist the implementation of research results. Each research project is unique and demands a customized strategy to implement its results. The Research Division uses appropriate strategies for each implementation effort. Practices listed below have high potential for boosting implementation effectiveness. These are the practices used most often by the Research Division to increase the effectiveness of the implementation effort:

- Real-user settings when performing pilot or demonstration projects;
- Ensures that the innovation is matched to the users' needs;
- Strong commitment from senior management for implementation of the innovation;
- Adequate funding to support the innovation;
- High degree of collaboration among users, researchers, and industry;
- User participation at vital stages of the research and development efforts;
- Innovation champions on site while implementation is being performed;
- High level of relevant technical skills by users who are properly prepared to deal with the innovation;
- Implementation package accompanies the innovation and continued technical support is available to the users during implementation;
- Clear goals identified for the implementation effort; and
- Funding specified for implementation efforts.

It is important to have an estimate of the cost-effectiveness of the innovation prior to implementation for comparison with existing methods. This allows managers to determine when the break-even point exists for the implementation strategy. A post evaluation with users is recommended to ascertain if the target benefits and costs are achieved. In summary the following information should be gathered when possible to facilitate implementation:

- Installation/application costs
- Cost effectiveness
- Performance and ease of application
- Safety aspects
- Needed modification
- Statistical and economic evaluations
- Assessment of the packaging and promotional effort
- Applicability to Utah's climate
- Maintainability issues

7.9 Experimental Projects and Demonstrations

Often the best way to show that a technology is an improvement over existing methods is to place it in the field as part of an Experimental Project (Section 6.2). This demonstrates that the technique can be constructed as designed, the product or material can be transported and handled, the installation can survive the high number of freeze-thaw cycles in Utah, and that the technique is cost-effective.

Training sessions or manuals are needed for some products and processes. Product vendors and suppliers should be used where necessary. Experienced experts from other state agencies or the FHWA may be required to ensure that the concept is designed and installed properly.

Documentation of the results of these projects and demonstrations is crucial to the continued use of the innovative product. New or revised specifications, special provisions used, examples of the design, and field construction notes can be very valuable to future personnel attempting to utilize the technology.

7.10 Conferences, Workshops, and Meetings

Opportunities to market new ideas are often available at conferences and workshops. The research staff should constantly be geared to take advantage of these opportunities. Presentations should be given at meetings conducted by groups such as the Materials Engineers, Maintenance Engineers, Construction Engineers, Motor Carrier staff, Administrators, Aeronautics experts, Community Relations personnel, Environmental Engineers, Geotechnical Engineers, Computer Experts, Planners, Structural Engineers, and Traffic & Safety Personnel. Tying into a group's agenda should be utilized to inform

staff members of new technology and receive input concerning the implementation of these products and processes.

7.11 Videoconferencing Programs

Use of the Department's videoconferencing system should be utilized as another tool to enhance implementation initiatives. Delivering technology over this system is a valuable asset for UDOT personnel. The decentralized nature of UDOT's organizational makeup makes distance learning and virtual meetings a must. A great deal of manpower and per diem outlay can be saved through the use of these tools. Although the need and value of face-to-face meetings will never be eliminated, certainly more experts can be exposed to new technologies by using videoconferencing and computer-aided systems.

Programs with neighboring states are also useful in the technology transfer initiative. The WASHTO-X Program is a topic specific peer exchange program, held monthly that can be used to distribute findings and obtain input by a larger group of experts. Special videoconferencing sessions should be scheduled for hot topics and pressing issues facing the national or regional transportation agencies.

7.12 Agency Emphasis on Implementation

Getting the results of research projects implemented into practice is crucial to the long-term success of a Research and Development Program, leading to innovation in the Department, and the continued support from management and funding agencies. Producing useable products and implementing them into operation should be a basic underlying philosophy in any transportation agency.

The entire Research and Development staff should constantly be aware of the need to move useable findings to the operating level. In some instances we tend to separate the phases of the study too much, and keep the implementation staff out of the loop until the research is completed. Once the products of the study are available, implementation personnel are given the task to market the work to the users. This is often a difficult or impossible task. Getting both the implementation staff and the end users involved throughout the study is an important process.

Various tools are available to enhance the implementation of research findings. Often combinations of implementation actions are needed to touch all of the needed levels of users and decision-makers in the loop. UDOT managers have set a goal for UDOT personnel to spend a portion of their time implementing new and innovative technologies and processes into their operations:

Implementation Staff	100%
Development Engineer	50%
Research & Development Engineer	25%
Research Project Managers	10%
UDOT Managers & Experts	1 to 3%

This represents a significant investment in resources for UDOT, but should help the organization to work smarter. The cost and time savings of these improvements have been shown to be passed on the traveling public.

SECTION 8- PERFORMANCE MEASURES AND PROGRAM FEEDBACK

Continuous improvement has been a requirement of the staff within the Utah Department of Transportation for many years. Performance measures and quality feedback loops are part of the Department culture. The Research Division is committed to internal performance measures, and routinely conducts studies that provide performance feedback to the divisions and regions in the Department.

8.1 Program Performance Measures

Expenditure of public funds is subject to careful scrutiny. Because the profit motive does not exist in the public arena, public programs that receive funds must prove their value in other ways. After careful selection of projects from problem statements and development of the work program, the research effort follows scrupulously defined procedures that ensure unbiased, meaningful results. Projects are evaluated to assess the cumulative effect of the program as a whole.

The overall performance of the research program is documented in a summation of the individual components of the program. The success of the specific research projects, technology transfer effort, and implementation of research results are good indicators of overall program performance. The Research Division keeps accurate records on all of its activities, costs, and accomplishments. Several parameters are used to evaluate overall program performance: success of implementation and technology transfer activities, milestones, funding and schedule adherence, benchmarking, peer exchange, and satisfaction of customer and management needs.

8.1.1 Implementation Results

Implementation of individual projects is discussed in Section 7, Implementation Program. Combining the summaries of the individual projects documents the progress for the entire program. The summaries include the actions at the following times:

- During project work plan preparation,
- At all project meetings,
- During project field visits, and
- At any specific implementation meeting.

In addition to the tabulations listed, partial- or full-project implementations are documented. Although a project may have been completed, subsequent implementation achievements are documented as they occur. Form 7-2 A, in the Appendix, is used for this purpose.

8.1.2 Milestones

The work program provides a summary of all research activities planned for the year: projects, technology transfer efforts, technical assistance, seminars, and implementation efforts. Milestones for these activities include the following:

- Project reports (refer to section 5.7, Project Level Reporting),
- Design of field installations,
- Field inspection visits for technical assistance,
- Public technical meetings and seminars,
- Information dissemination.

Attainment of each of these milestones is documented.

8.1.3 Funding Adherence

Each funding source in the work program has a fiscal year limitation and each activity has a specific budget. A record of both the funding source and budgeted project expenditures is kept. Allowances are made for over-expending on the individual SPR projects for the year, but the total program funds for SPR or other funding sources cannot be exceeded. Individual project overruns are documented.

8.1.4 Schedule Adherence

Projects are the most important scheduled activities. Most other activities can be planned throughout the year. Adherence to the project schedule is contingent on many factors, so the principal investigator and unit manager must be in frequent communication to avert major slippage.

Quarterly reports compare the planned to the actual project progress. A table shows the number of projects that are ahead of schedule, on time, and behind schedule. Qualifying statements are made for those projects that are behind schedule. Form 11-1 in the Appendix is used for this purpose.

8.1.5 Benchmarking

The achievements of the research program cannot be easily shown on a total performance basis—the diversity of the activities is too great to permit their summation. However, the quality of the program can be judged by observing, over time, the progress of some of the measurable parameters. Benchmarking demonstrates research progress and shows quality changes. Some of the factors that are benchmarked to show the performance of the program are as follows:

- Programmed funds,
- Staff research projects,
- Contract research projects, and
- Milestones achieved.

8.2 Program Feedback

8.2.1 Peer Exchange Program

The UDOT Research Division is required to conduct a Research Peer Exchange with other state transportation research programs on a three-year cycle. This process facilitates the positive exchange of knowledge, which enhances UDOT's management, policies, processes, and work program. The Peer Exchange is a forum for professionals in the transportation field to share knowledge about research activities.

The event can be an exchange that examines either the full management process or a focused area within the State's program. The focus topic can be something identified in the earlier rounds of peer exchanges, or a topic on which the host State was seeking advice. Topics may include topics such as security; contract and claim reporting requirements; how to market research results; implementation of research findings; how to identify the value of research; evaluation of programs and project performance; program administration and project selection; how to increase industry involvement; ways to improve information sharing; how to improve the quality and accuracy of preliminary research cost estimates; methods for evaluating principal investigators; and examination of implementation of research results.

The peer exchange panel of four to five people should include participants from other State research programs, Federal Highway Administration (FHWA) staff, universities, or others. At least one or two of the panel members should have participated in previous peer exchange panels. Travel and other costs associated with a State DOT's peer exchange are eligible for 100 percent Federal funding with SP&R funds. FHWA has issued guidelines that should be helpful in setting up and conducting a peer exchange.

Reports regarding the focus and findings of the peer exchange are required. One copy of the report should be sent to the FHWA Office of Program Development and Evaluation (HRPD-01, 6300 Georgetown Pike, McLean, VA 22101). State DOTs are also encouraged to post their peer exchange reports on the RAC website.

It is important for managers in the UDOT Research Division to travel to peer exchange sessions in other states to bring back ideas and concepts that may improve UDOT research operations.

8.2.2 Exit Surveys

Detailed feedback is a very important on a project-by-project basis. An "Exit Survey" form has been developed to gather information from customers in a complete and consistent manner. An "Exit Survey" form is provided in Appendix B.

Improvements in how projects are developed, managed, and monitored can be achieved by compiling feedback provided by our customers. TAC members, champions, end-

users, and PIs should be asked to complete the feedback loop through the "Exit Survey" and open discussions.

8.2.3 Benefit-Cost Studies

Studies should be undertaken to measure the benefits of research. Every three to five years an estimate of the benefit-cost ratios of the research program should be estimated. The analysis should include all major projects and initiatives completed during that time period.

These studies estimate the benefits of UDOT's major research projects, and make comparisons with the costs expended conduct the studies. In addition estimates are provided for the benefits of various types of projects, including those related to infrastructure, operations, administration, and policy research.

Some research initiatives are not fully implemented immediately after the project is completed. For this reason it is necessary to allow a period of time between the project completion and the estimation of the benefits of the deliverables. By allowing this time period end users of the research products have had sufficient time to determine if the concept will really work as reported, and a better estimation of the benefits will emerge.

The benefits and costs of individual projects are estimated to acquire composite values for the study period. The main objective of the analysis should be:

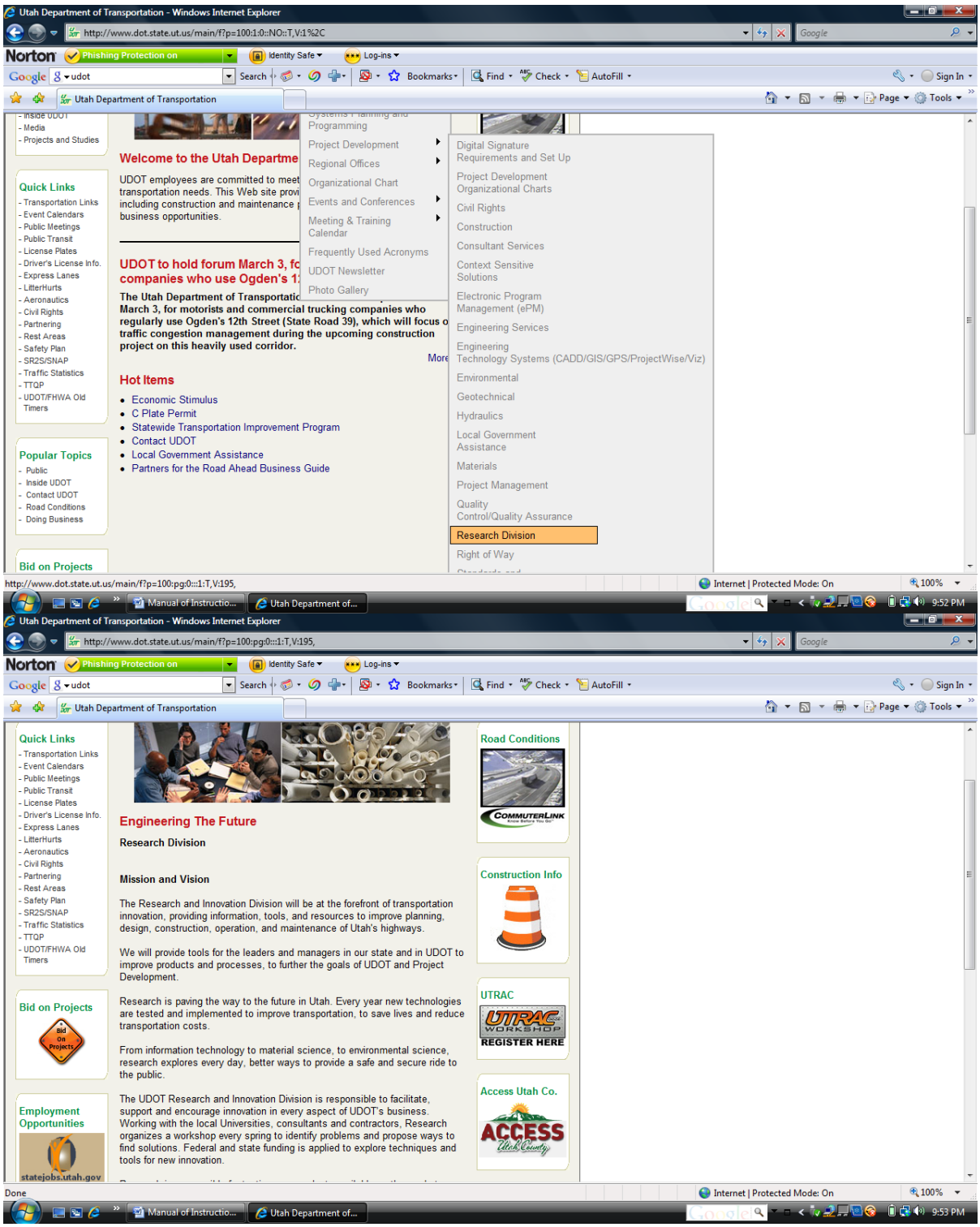
- Estimate the benefits of major research projects and compare them with the costs to conduct the studies.
- Determine which types of projects produce the highest benefit-cost ratios and which projects are more often unsuccessful or marginal.
- Make recommendations concerning the research program and the types of projects undertaken in the future.

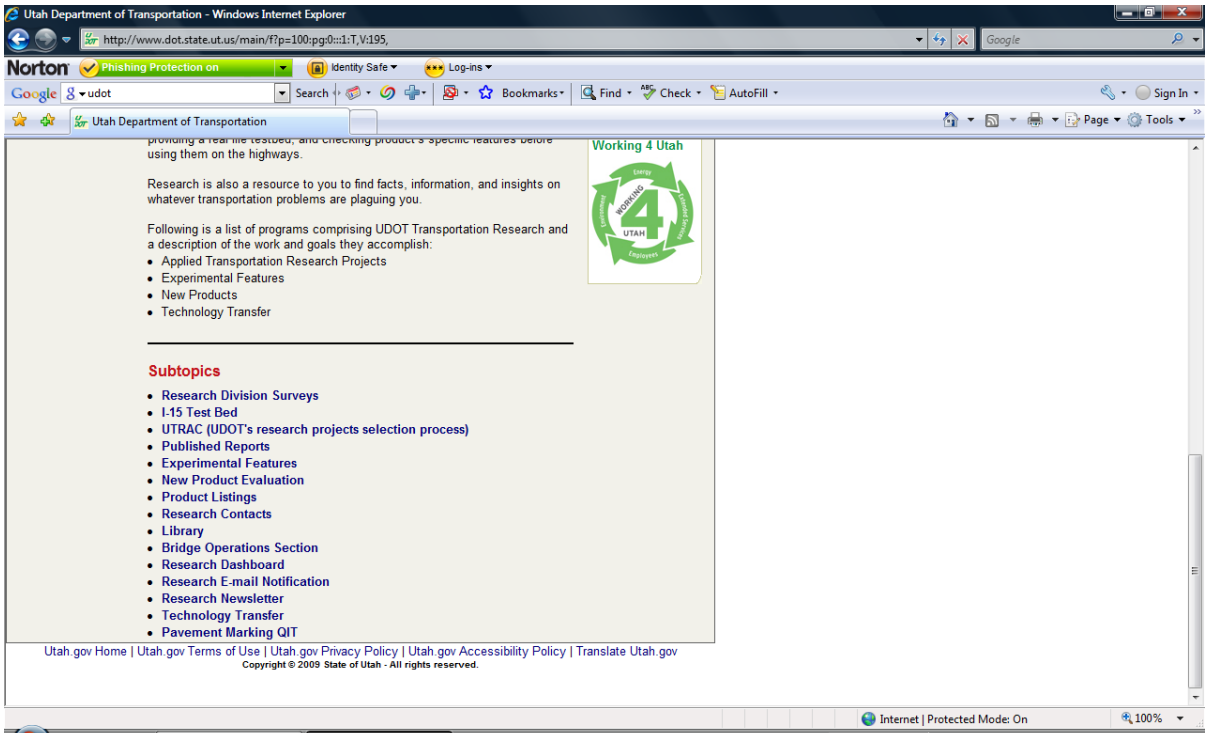
The following table shows the results of a previous benefit-cost study:

Benefits of Research & Development Projects by Category

Category	Cost- $k	Benefit-$k	Benefit/Cost
Infrastructure	$482	$7,270	15
Operations	$297	$3,815	13
Administration	$31	$200	6
Policy	$164	$800	5
Total 3-Year	**$974**	**$12,085**	**12**

Appendix A- Examples of Web Pages

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Utah Department of Transportation
providing a real life testbed, and checking product's specific features before using them on the highways.
Research is also a resource to you to find facts, information, and insights on whatever transportation problems are plaguing you.
Following is a list of programs comprising UDOT Transportation Research and a description of the work and goals they accomplish:
Applied Transportation Research Projects
Experimental Features
New Products
Technology Transfer
Working 4 Utah
Subtopics
Research Division Surveys
I-15 Test Bed
UTRAC (UDOT's research projects selection process)
Published Reports
Experimental Features
New Product Evaluation
Product Listings
Research Contacts
Library
Bridge Operations Section
Research Dashboard
Research E-mail Notification
Research Newsletter
Technology Transfer
Pavement Marking QIT
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Copyright © 2009 State of Utah - All rights reserved.
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- Transportation Links
- Event Calendars
- Public Meetings
- Public Transit
- License Plates
- Driver's License Info.
- Express Lanes
- LitterHurts
- Aeronautics
- Civil Rights
- Partnering
- Rest Areas
- Safety Plan
- SR2S/SNAP
- Traffic Statistics
- TTQP
- UDOT/FHWA Old Timers
Bid on Projects
Employment Opportunities
RESEARCH
ENGINEERING THE FUTURE
Utah Transportation Research Advisory Council (UTRAC)
Each year a workshop is held to help the Research and Development Division identify potential research for its annual program. The meeting's emphasis is to isolate issues and topics that are inherent to UDOT's strategic goals. Through these open and aggressive sessions, users have an opportunity to express their needs and offer strategies that will keep UDOT on the leading edge of highway technology. Details about each workshop and the prioritized projects are found on the subsequent pages.
Submitting Problem Statements
Research Problem Statements must be submitted in advance of the UTRAC Workshop for consideration for funding during the next fiscal year. The "Problem Statement" form is available in the download dialogue box on this page. These should be submitted to the group leader of the applicable Workshop Topic Group, or to the Research Division, Esther Olsen, (801) 965-4568, fax (801) 965-4564, eolsen@utah.gov. The next workshop will take place in April 2009 and the deadline for submissions is in March 2009.
Proceedings of Previous Workshops
For copies of the hard copy proceedings of any of the previous UTRAC Workshops, contact the Research Division, c/o Abdul Wakil, awakil@utah.gov.
Subtopics
UTRAC Workshops
Road Conditions
CommuterLink
Construction Info
UTRAC
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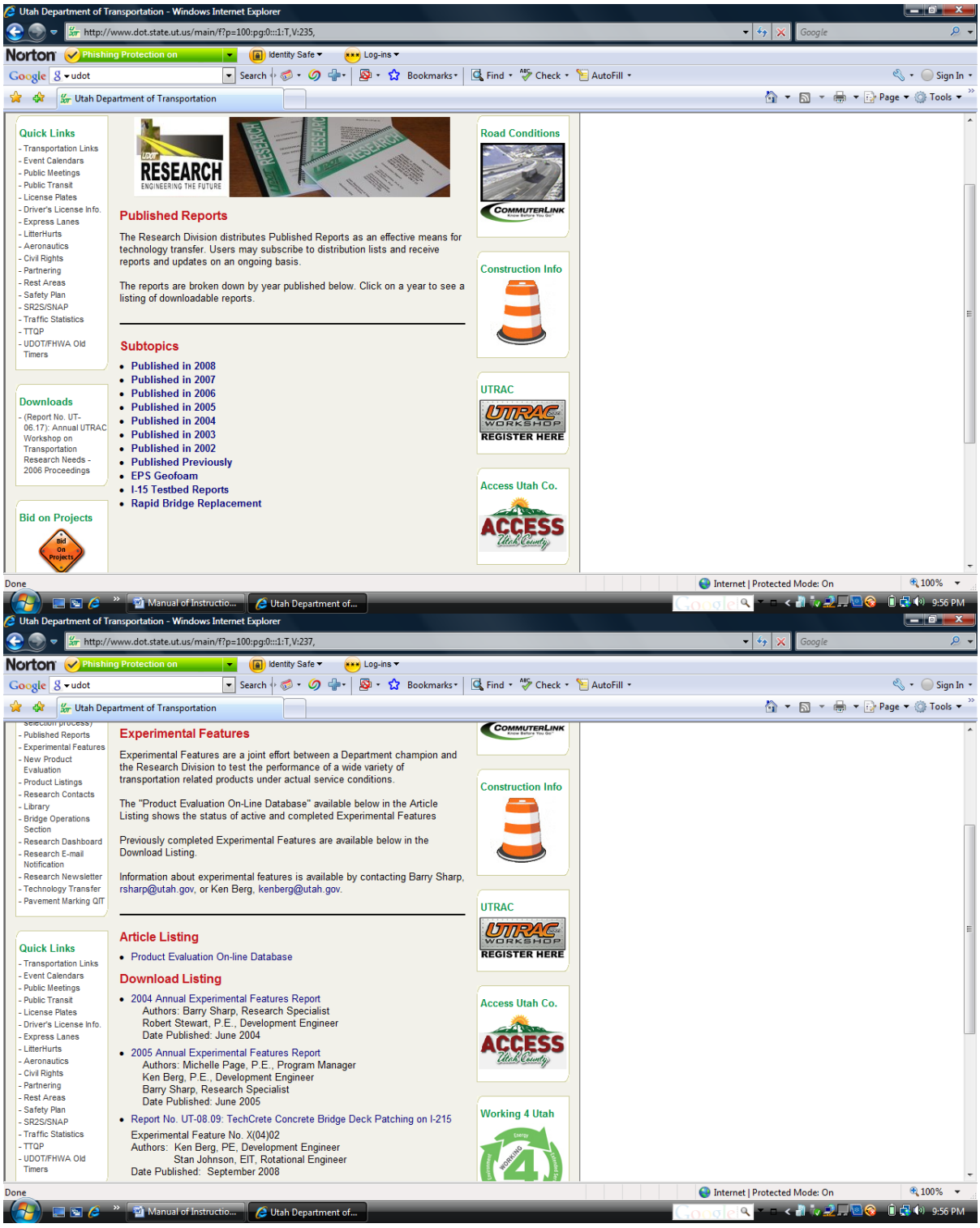
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- Transportation Links
- Event Calendars
- Public Meetings
- Public Transit
- License Plates
- Driver's License Info.
- Express Lanes
- LitterHurts
- Aeronautics
- Civil Rights
- Partnering
- Rest Areas
- Safety Plan
- SR2S/SNAP
- Traffic Statistics
- TTQP
- UDOT/FHWA Old Timers
Downloads
- (Report No. UT-06.17): Annual UTRAC Workshop on Transportation Research Needs - 2006 Proceedings
Bid on Projects
RESEARCH
ENGINEERING THE FUTURE
Published Reports
The Research Division distributes Published Reports as an effective means for technology transfer. Users may subscribe to distribution lists and receive reports and updates on an ongoing basis.
The reports are broken down by year published below. Click on a year to see a listing of downloadable reports.
Subtopics
Published in 2008
Published in 2007
Published in 2006
Published in 2005
Published in 2004
Published in 2003
Published in 2002
Published Previously
EPS Geofoam
I-15 Testbed Reports
Rapid Bridge Replacement
Road Conditions
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- Published Reports
- Experimental Features
- New Product Evaluation
- Product Listings
- Research Contacts
- Library
- Bridge Operations Section
- Research Dashboard
- Research E-mail Notification
- Research Newsletter
- Technology Transfer
- Pavement Marking QIT
Quick Links
- Transportation Links
- Event Calendars
- Public Meetings
- Public Transit
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- Driver's License Info.
- Express Lanes
- LitterHurts
- Aeronautics
- Civil Rights
- Partnering
- Rest Areas
- Safety Plan
- SR2S/SNAP
- Traffic Statistics
- TTQP
- UDOT/FHWA Old Timers
Experimental Features
Experimental Features are a joint effort between a Department champion and the Research Division to test the performance of a wide variety of transportation related products under actual service conditions.
The "Product Evaluation On-Line Database" available below in the Article Listing shows the status of active and completed Experimental Features
Previously completed Experimental Features are available below in the Download Listing.
Information about experimental features is available by contacting Barry Sharp, rsharp@utah.gov, or Ken Berg, kenberg@utah.gov.
Article Listing
Product Evaluation On-line Database
Download Listing
2004 Annual Experimental Features Report
Authors: Barry Sharp, Research Specialist
Robert Stewart, P.E., Development Engineer
Date Published: June 2004
2005 Annual Experimental Features Report
Authors: Michelle Page, P.E., Program Manager
Ken Berg, P.E., Development Engineer
Barry Sharp, Research Specialist
Date Published: June 2005
Report No. UT-08.09: TechCrete Concrete Bridge Deck Patching on I-215
Experimental Feature No. X(04)02
Authors: Ken Berg, PE, Development Engineer
Stan Johnson, EIT, Rotational Engineer
Date Published: September 2008
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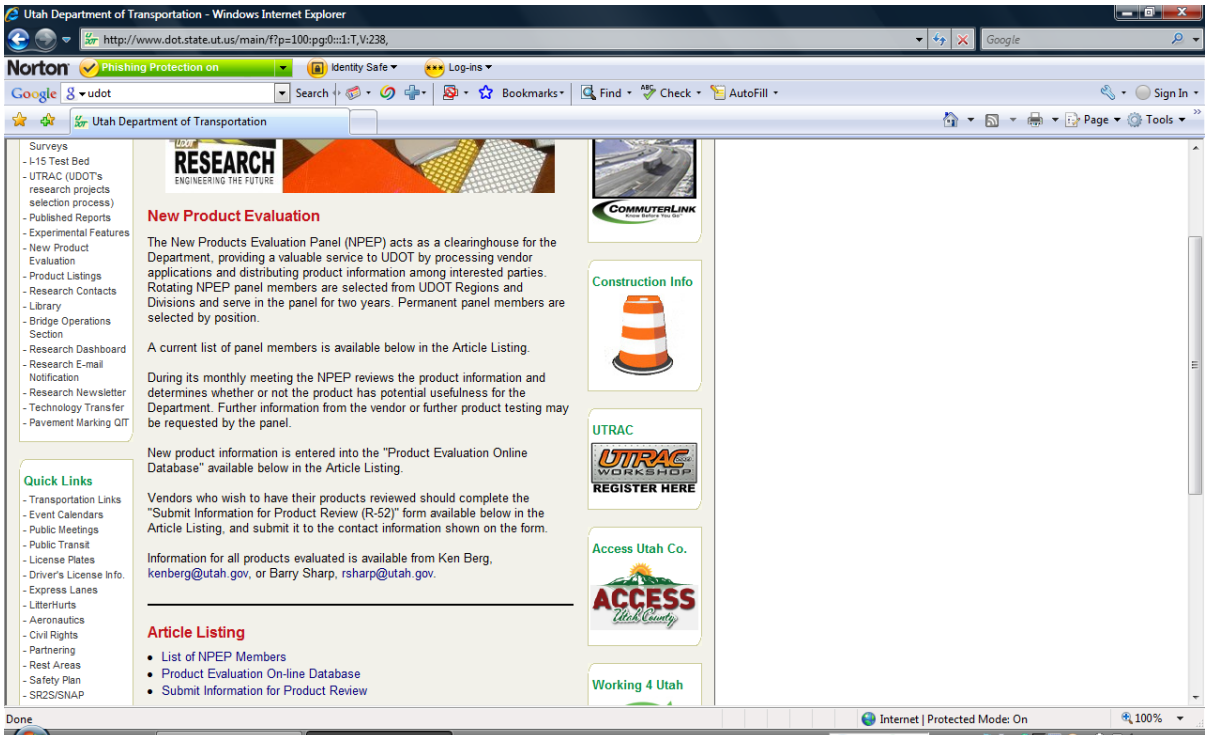
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Utah Department of Transportation
Surveys
- I-15 Test Bed
- UTRAC (UDOT's research projects selection process)
- Published Reports
- Experimental Features
- New Product Evaluation
- Product Listings
- Research Contacts
- Library
- Bridge Operations Section
- Research Dashboard
- Research E-mail Notification
- Research Newsletter
- Technology Transfer
- Pavement Marking QIT
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- Express Lanes
- LitterHurts
- Aeronautics
- Civil Rights
- Partnering
- Rest Areas
- Safety Plan
- SR2S/SNAP
RESEARCH
ENGINEERING THE FUTURE
New Product Evaluation
The New Products Evaluation Panel (NPEP) acts as a clearinghouse for the Department, providing a valuable service to UDOT by processing vendor applications and distributing product information among interested parties. Rotating NPEP panel members are selected from UDOT Regions and Divisions and serve in the panel for two years. Permanent panel members are selected by position.
A current list of panel members is available below in the Article Listing.
During its monthly meeting the NPEP reviews the product information and determines whether or not the product has potential usefulness for the Department. Further information from the vendor or further product testing may be requested by the panel.
New product information is entered into the "Product Evaluation Online Database" available below in the Article Listing.
Vendors who wish to have their products reviewed should complete the "Submit Information for Product Review (R-52)" form available below in the Article Listing, and submit it to the contact information shown on the form.
Information for all products evaluated is available from Ken Berg, kenberg@utah.gov, or Barry Sharp, rsharp@utah.gov.
Article Listing
- List of NPEP Members
- Product Evaluation On-line Database
- Submit Information for Product Review
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Access Utah Co.
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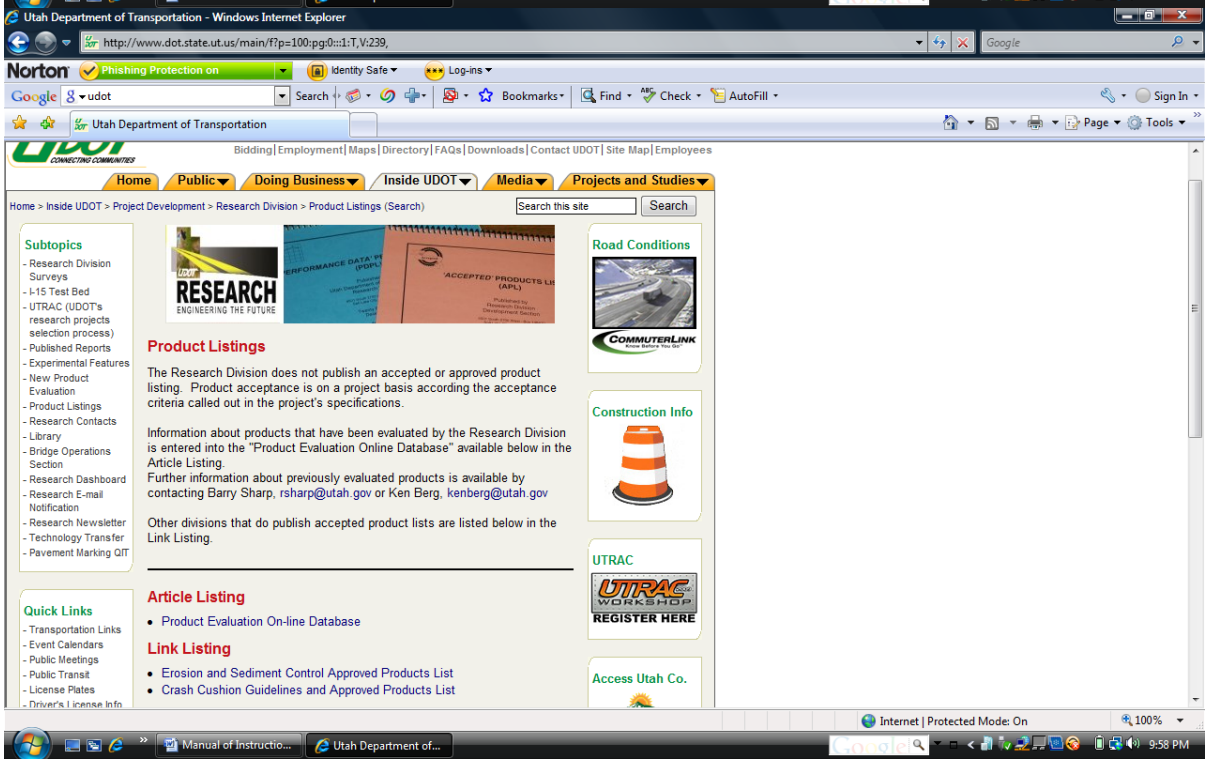
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Utah Department of Transportation
Bidding | Employment | Maps | Directory | FAQs | Downloads | Contact UDOT | Site Map | Employees
Home
Public
Doing Business
Inside UDOT
Media
Projects and Studies
Home > Inside UDOT > Project Development > Research Division > Product Listings (Search)
Search this site
Search
Subtopics
- Research Division Surveys
- I-15 Test Bed
- UTRAC (UDOT's research projects selection process)
- Published Reports
- Experimental Features
- New Product Evaluation
- Product Listings
- Research Contacts
- Library
- Bridge Operations Section
- Research Dashboard
- Research E-mail Notification
- Research Newsletter
- Technology Transfer
- Pavement Marking QIT
Quick Links
- Transportation Links
- Event Calendars
- Public Meetings
- Public Transit
- License Plates
RESEARCH
ENGINEERING THE FUTURE
Product Listings
The Research Division does not publish an accepted or approved product listing. Product acceptance is on a project basis according the acceptance criteria called out in the project's specifications.
Information about products that have been evaluated by the Research Division is entered into the "Product Evaluation Online Database" available below in the Article Listing.
Further information about previously evaluated products is available by contacting Barry Sharp, rsharp@utah.gov or Ken Berg, kenberg@utah.gov
Other divisions that do publish accepted product lists are listed below in the Link Listing.
Article Listing
- Product Evaluation On-line Database
Link Listing
- Erosion and Sediment Control Approved Products List
- Crash Cushion Guidelines and Approved Products List
Road Conditions
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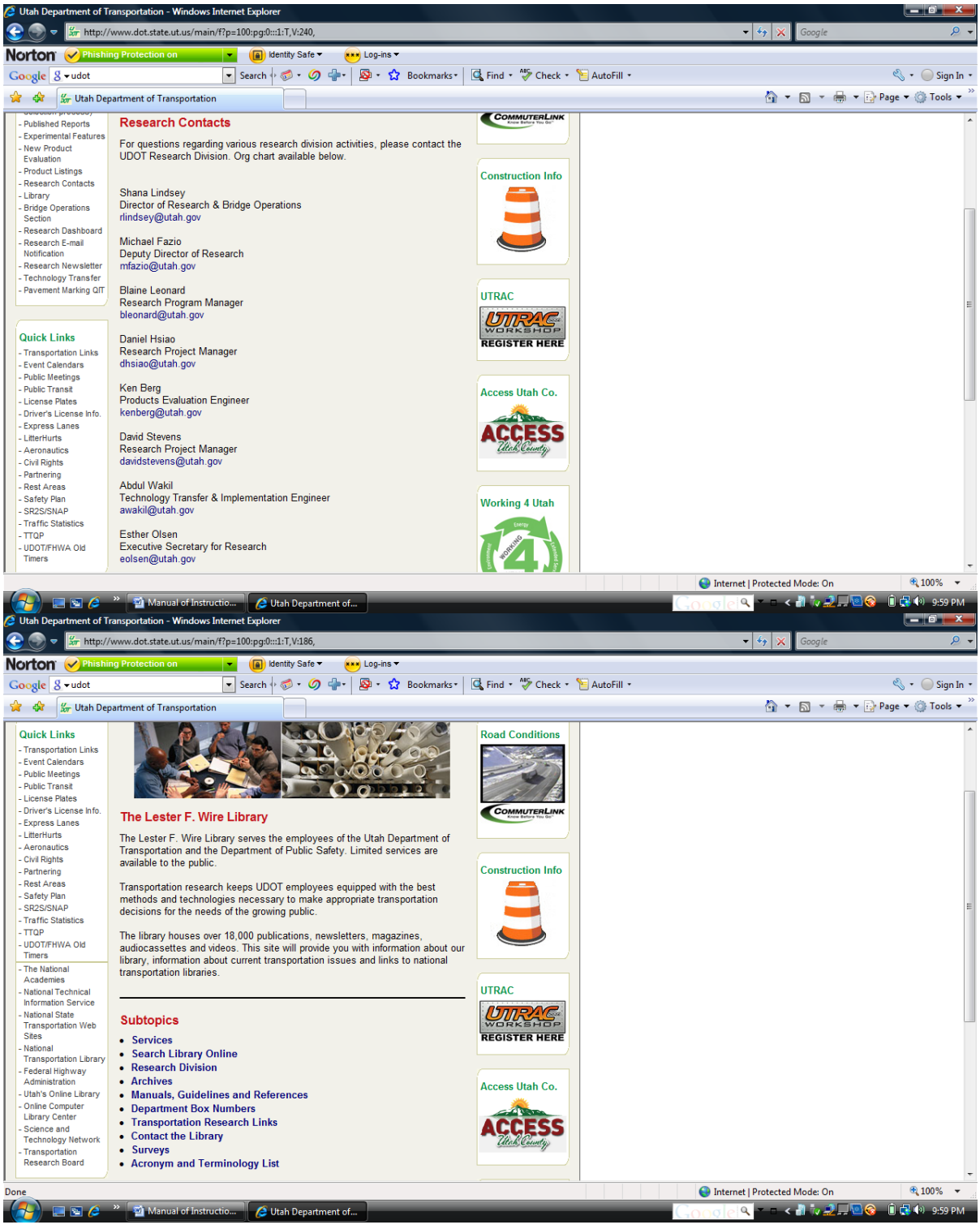
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- Published Reports
- Experimental Features
- New Product Evaluation
- Product Listings
- Research Contacts
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- Bridge Operations Section
- Research Dashboard
- Research E-mail Notification
- Research Newsletter
- Technology Transfer
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- Event Calendars
- Public Meetings
- Public Transit
- License Plates
- Driver's License Info.
- Express Lanes
- LitterHurts
- Aeronautics
- Civil Rights
- Partnering
- Rest Areas
- Safety Plan
- SR2S/SNAP
- Traffic Statistics
- TTQP
- UDOT/FHWA Old Timers
Research Contacts
For questions regarding various research division activities, please contact the UDOT Research Division. Org chart available below.
Shana Lindsey
Director of Research & Bridge Operations
rlindsey@utah.gov
Michael Fazio
Deputy Director of Research
mfazio@utah.gov
Blaine Leonard
Research Program Manager
bleonard@utah.gov
Daniel Hsiao
Research Project Manager
dhsiao@utah.gov
Ken Berg
Products Evaluation Engineer
kenberg@utah.gov
David Stevens
Research Project Manager
davidstevens@utah.gov
Abdul Wakil
Technology Transfer & Implementation Engineer
awakil@utah.gov
Esther Olsen
Executive Secretary for Research
eolsen@utah.gov
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- License Plates
- Driver's License Info.
- Express Lanes
- LitterHurts
- Aeronautics
- Civil Rights
- Partnering
- Rest Areas
- Safety Plan
- SR2S/SNAP
- Traffic Statistics
- TTQP
- UDOT/FHWA Old Timers
- The National Academies
- National Technical Information Service
- National State Transportation Web Sites
- National Transportation Library
- Federal Highway Administration
- Utah's Online Library
- Online Computer Library Center
- Science and Technology Network
- Transportation Research Board
The Lester F. Wire Library
The Lester F. Wire Library serves the employees of the Utah Department of Transportation and the Department of Public Safety. Limited services are available to the public.
Transportation research keeps UDOT employees equipped with the best methods and technologies necessary to make appropriate transportation decisions for the needs of the growing public.
The library houses over 18,000 publications, newsletters, magazines, audiocassettes and videos. This site will provide you with information about our library, information about current transportation issues and links to national transportation libraries.
Subtopics
Services
Search Library Online
Research Division
Archives
Manuals, Guidelines and References
Department Box Numbers
Transportation Research Links
Contact the Library
Surveys
Acronym and Terminology List
Road Conditions
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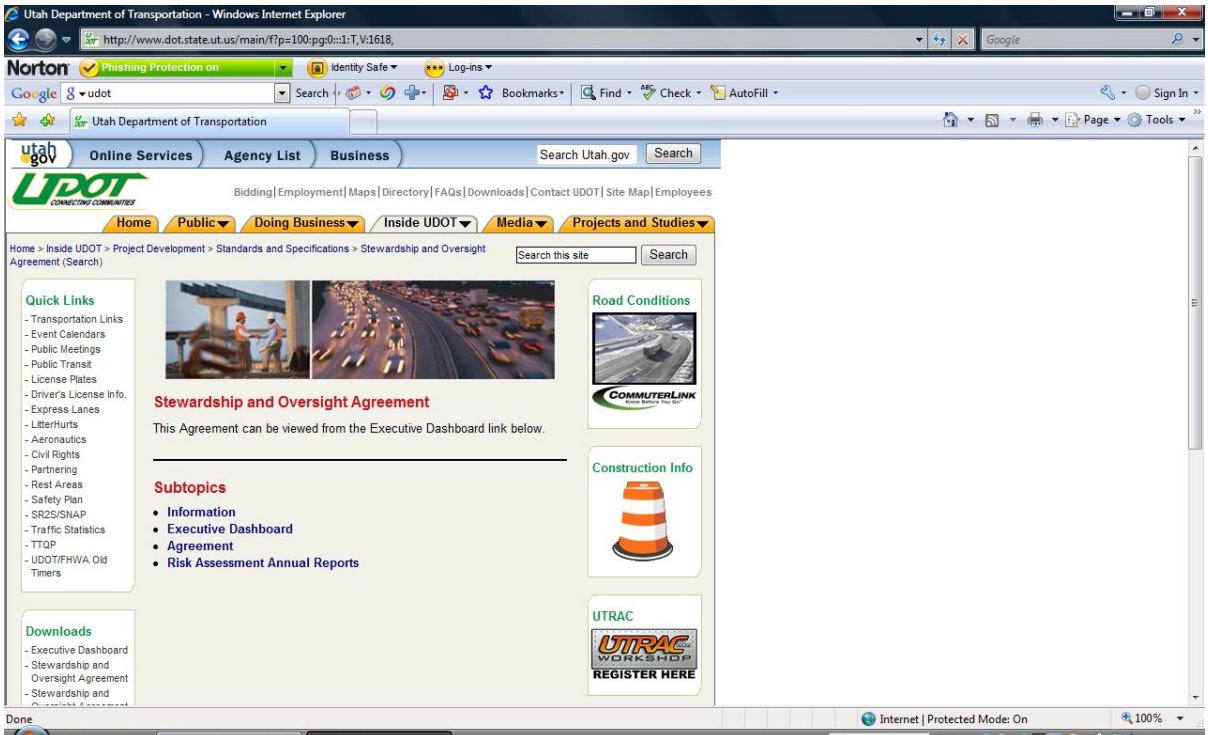
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Online Services
Agency List
Business
Search Utah.gov
Search
UDOT
Bidding | Employment | Maps | Directory | FAQs | Downloads | Contact UDOT | Site Map | Employees
Home
Public
Doing Business
Inside UDOT
Media
Projects and Studies
Home > Inside UDOT > Project Development > Standards and Specifications > Stewardship and Oversight Agreement (Search)
Search this site
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Quick Links
- Transportation Links
- Event Calendars
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- SR2S/SNAP
- Traffic Statistics
- TTQP
- UDOT/FHWA Old Timers
Downloads
- Executive Dashboard
- Stewardship and Oversight Agreement
- Stewardship and
Stewardship and Oversight Agreement
This Agreement can be viewed from the Executive Dashboard link below.
Subtopics
Information
Executive Dashboard
Agreement
Risk Assessment Annual Reports
Road Conditions
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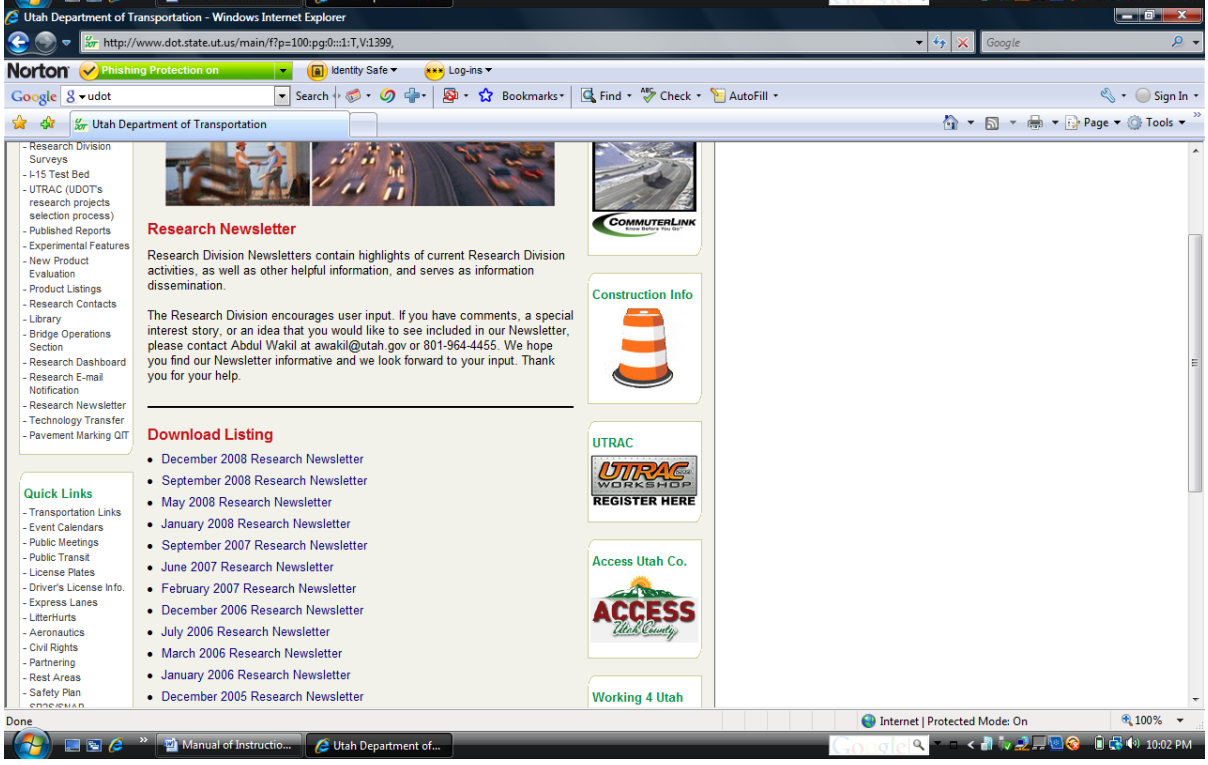
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Utah Department of Transportation
- Research Division Surveys
- I-15 Test Bed
- UTRAC (UDOT's research projects selection process)
- Published Reports
- Experimental Features
- New Product Evaluation
- Product Listings
- Research Contacts
- Library
- Bridge Operations Section
- Research Dashboard
- Research E-mail Notification
- Research Newsletter
- Technology Transfer
- Pavement Marking QIT
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- Event Calendars
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- Public Transit
- License Plates
- Driver's License Info.
- Express Lanes
- LitterHurts
- Aeronautics
- Civil Rights
- Partnering
- Rest Areas
- Safety Plan
Research Newsletter
Research Division Newsletters contain highlights of current Research Division activities, as well as other helpful information, and serves as information dissemination.
The Research Division encourages user input. If you have comments, a special interest story, or an idea that you would like to see included in our Newsletter, please contact Abdul Wakil at awakil@utah.gov or 801-964-4455. We hope you find our Newsletter informative and we look forward to your input. Thank you for your help.
Download Listing
December 2008 Research Newsletter
September 2008 Research Newsletter
May 2008 Research Newsletter
January 2008 Research Newsletter
September 2007 Research Newsletter
June 2007 Research Newsletter
February 2007 Research Newsletter
December 2006 Research Newsletter
July 2006 Research Newsletter
March 2006 Research Newsletter
January 2006 Research Newsletter
December 2005 Research Newsletter
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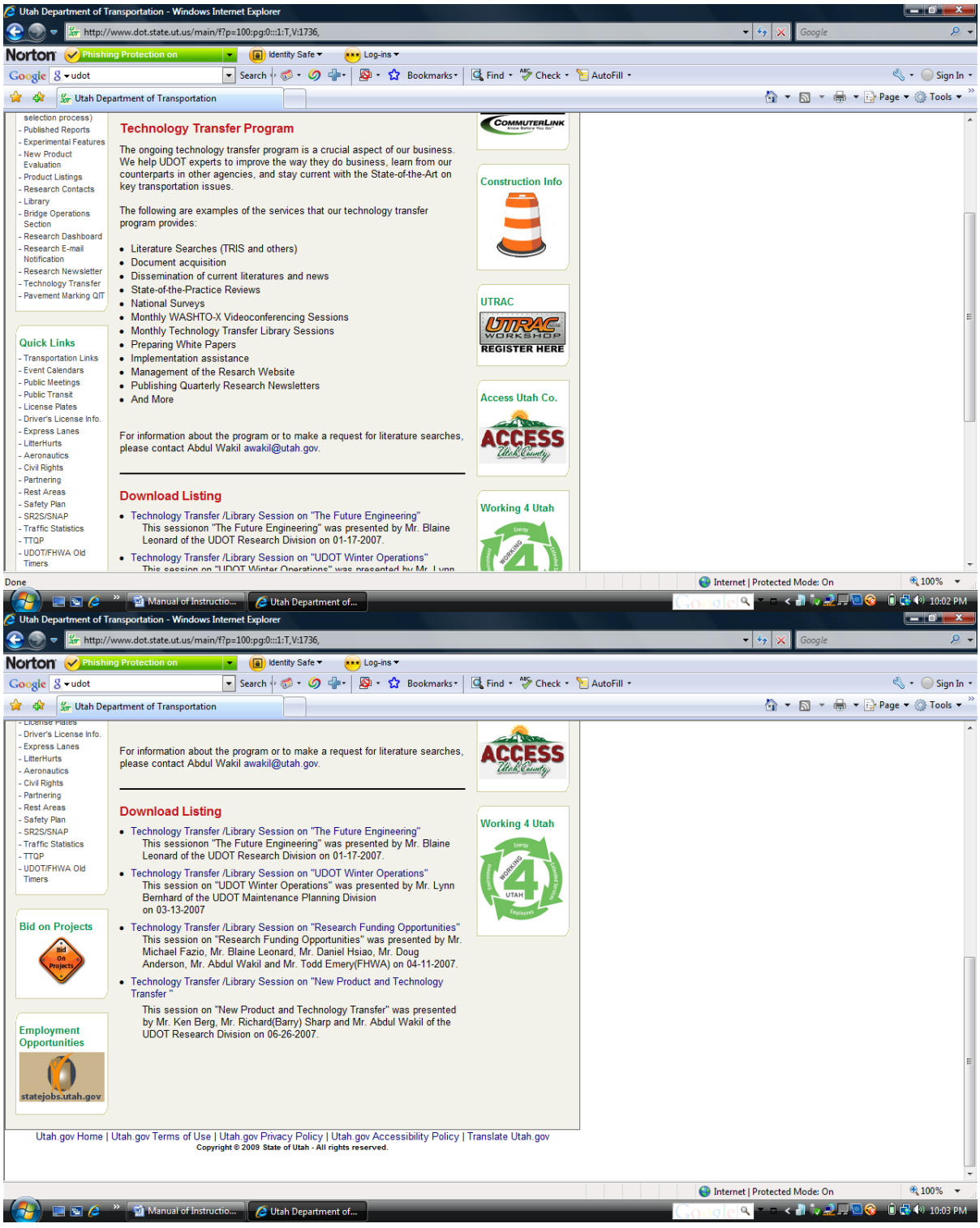
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- Bridge Operations Section
- Research Dashboard
- Research E-mail Notification
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- Express Lanes
- LitterHurts
- Aeronautics
- Civil Rights
- Partnering
- Rest Areas
- Safety Plan
- SR2S/SNAP
- Traffic Statistics
- TTQP
- UDOT/FHWA Old Timers
Technology Transfer Program
The ongoing technology transfer program is a crucial aspect of our business. We help UDOT experts to improve the way they do business, learn from our counterparts in other agencies, and stay current with the State-of-the-Art on key transportation issues.
The following are examples of the services that our technology transfer program provides:
- Literature Searches (TRIS and others)
- Document acquisition
- Dissemination of current literatures and news
- State-of-the-Practice Reviews
- National Surveys
- Monthly WASHTO-X Videoconferencing Sessions
- Monthly Technology Transfer Library Sessions
- Preparing White Papers
- Implementation assistance
- Management of the Resarch Website
- Publishing Quarterly Research Newsletters
- And More
For information about the program or to make a request for literature searches, please contact Abdul Wakil awakil@utah.gov.
Download Listing
- Technology Transfer /Library Session on "The Future Engineering"
This sessionon "The Future Engineering" was presented by Mr. Blaine Leonard of the UDOT Research Division on 01-17-2007.
- Technology Transfer /Library Session on "UDOT Winter Operations"
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- Express Lanes
- LitterHurts
- Aeronautics
- Civil Rights
- Partnering
- Rest Areas
- Safety Plan
- SR2S/SNAP
- Traffic Statistics
- TTQP
- UDOT/FHWA Old Timers
For information about the program or to make a request for literature searches, please contact Abdul Wakil awakil@utah.gov.
Download Listing
- Technology Transfer /Library Session on "The Future Engineering"
This sessionon "The Future Engineering" was presented by Mr. Blaine Leonard of the UDOT Research Division on 01-17-2007.
- Technology Transfer /Library Session on "UDOT Winter Operations"
This session on "UDOT Winter Operations" was presented by Mr. Lynn Bernhard of the UDOT Maintenance Planning Division on 03-13-2007
- Technology Transfer /Library Session on "Research Funding Opportunities"
This session on "Research Funding Opportunities" was presented by Mr. Michael Fazio, Mr. Blaine Leonard, Mr. Daniel Hsiao, Mr. Doug Anderson, Mr. Abdul Wakil and Mr. Todd Emery(FHWA) on 04-11-2007.
- Technology Transfer /Library Session on "New Product and Technology Transfer "
This session on "New Product and Technology Transfer" was presented by Mr. Ken Berg, Mr. Richard(Barry) Sharp and Mr. Abdul Wakil of the UDOT Research Division on 06-26-2007.
Bid on Projects
Employment Opportunities
statejobs.utah.gov
Utah.gov Home | Utah.gov Terms of Use | Utah.gov Privacy Policy | Utah.gov Accessibility Policy | Translate Utah.gov
Copyright © 2009 State of Utah - All rights reserved.
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Appendix B- Research Forms

Figure B1- Preliminary Information for Product Evaluation Form R-52- Page 1

Utah Department of Transportation
Research and Development Division

I.D. FILE #_____

PRELIMINARY INFORMATION FOR PRODUCT EVALUATION

Form R-52 (Rev. 11/08)

INSTRUCTIONS: Please answer ALL questions. If a question is not applicable, please enter "N/A."

1. Tradename:_____

2. Description:_____

3. Outstanding features or claimed advantages:_____

4. Recommended use:_____

5. Tested by others (eg. NTPEP, TTI, FHWA, independent lab, etc.):_____

6. Meets the following standards:
   - ASTM_____
   - AASHTO_____
   - Federal_____
   - Other_____

7. Manufacturer_____
   - Street address_____
   - City_____
   - State_____
   - Zip_____
   - Phone_____
   - Fax_____
   - Website_____
   - Contact Name_____
   - Company background_____

Figure B1- Preliminary Information for Product Evaluation Form R-52- Page 2

8. Distributor_____
   Street address_____
   City_____
   State_____
   Zip_____
   Phone_____
   Fax_____
   Website_____
   Contact Name_____

Please attach product specific supplemental literature and submit to:

UDOT - - Research Division
4501 South 2700 West
Box 148410
Salt Lake City, UT 84114-8410
Fax (801) 965-4796

Attn: Barry Sharp

For your questions or comments our engineering staff is available Mon.-Thurs. from 7am to 5:30pm (MST),

Michael Fazio, P.E.
Research Deputy Director
(801) 957-8595
mfazio@utah.gov

Ken Berg, P.E.
Development Engineer
(801) 965-4321
kenberg@utah.gov

R. Barry Sharp
Research Specialist
(801) 965-4314
rsharp@utah.gov

Figure B2- EXPERIMENTAL FEATURE WORK PLAN

Experimental Feature No.:

Submitted By: **Date:**	
UDOT Champion Names & Titles:	
Problem Statement (Background, reason for choosing, :	
Objectives (comparison to standard or method, desired knowledge:	
Previous Research Results: (Literature search, other DOT's, etc.)	
Proposed Title:	
Location Desc.: **Region/District:** **Route & MP:** **Maint Sta. & Supervisor:** Current Yr. AADT: Stucture No.: Project No.: (attached applicable drawings, specs, estimate)	
Cost/Duration: **Product Trade Name:** **(attach completed R-52 form)** **Supplier:**	

Schedule of Data Collection and Evaluation

Item	Personnel assigned	Due Date
Product Installation/ Control Data		
Construction Report		
Interim Report		
Final Report Submitted by		

O:\Exp Features\XF Work J:\Experimental Features\0 Forms\1 Work Plan\XF Work Plan & Const Rpt Template.docPlan & Const Rpt Template.wpd

Figure B3- Project Feedback Survey

-Research Project Feedback Survey-

by
Technical Advisory Committee (TAC)
and Project Champions

Please rate the following questions as:

5-very good, 4-good, 3-fair, 2-poor, 1-very poor

1-How well did the study meet the objectives listed in the Problem Statement?_____

2-What was the quality of the Work Plan prepared and approved by the TAC?_____

3-Were the appropriate divisions, regions, and stakeholders represented on the TAC?____

4-How well did the Principal Investigator perform and meet your expectations?_____

5-How well did the Project Manager from the Research Division coordinate with other divisions and agencies, monitor TAC activities, and administer the project contract?_____

6-How well did the Research Division support the project with funding and other resources?
_____

7-What was the quality of the reports and other deliverables?_____

8-Was implementation adequately addressed and anticipated during the study?_____

9-How well were implementation strategies defined and outlined in the final report?_____

10-How would you rate the chance for successful implementation of the study recommendations and products?_____

11-Was sufficient funding allocated for the study tasks?____

12-What grade would give this study overall? A, B, C, D or E (circle one)

Grade	Description
A	Major impact- Revised operations (spec, policy, etc.)
B	Significant impact- Improved operations
C	Contributed to state-of-the-art
D	Unclear or contradicting findings- More study needed
E	Major tasks not completed- Objectives not met

Comments or suggestions: (Use additional sheets if needed)

Figure B4- Contract Document Preparation Information

Project Manager: _____

_____

Contract Cover Sheet:

Project Title:

.

Contract Amount: $_____.

Contract Period (add 6 to 12 months for extensions & invoicing) _____to

.

Contractor: U of U Civil Engineering____, U of U Other Dept ___,
USU Civil Engineering____, USU Other Dept ____,
BYU Civil Engineering____, BYU Other Dept ____,
Private Consultant or Agency Department:
Company Name

.

Contracts Officer

.

Address

.

_____

_____.

Phone

.

Fax

.

Attachment A: State Consultant _____, Private Consultant_____.

Attachment B:

Prepared by the Project Manager and reviewed by the contracts technician.

Attachment C:

Scope of Work: Prepared by the Project Manager or the Consultant, and reviewed the TAC.

*Safety training required for all consultants visiting the construction site.

August 2005

Figure B5- Contract Title Page

FI84A 9/96
Division of Finance

STATE OF UTAH CONTRACT

CONTRACT NUMBER: _____

1. **CONTRACTING PARTIES**: This contract is between the following agency of the State of Utah:

STATE AGENCY: Department of Transportation — Agency Code: 810
Agency Division: Research

Referred to herein as the DEPARTMENT and the following named contractor, referred to herein as the CONTRACTOR:

CONTRACTOR: University of Utah, Office of Sponsored Projects — Legal Status: Government Agency
Street Address: 1471 Federal Way
City / State / Zip Code: Salt Lake City, Utah 84102

Elliot C. Kulakowski
Phone Number: (801) 581-3008

Federal Identification Number: Exempt — Vendor Number: 17361G — Commodity Codes: 95670000000

2. **CONTRACT TYPE AND PURPOSE**:

Sole source research study. Contract Title: **On-Line Traffic Assessment of Creative Highway Administration Techniques**

3. **PROCUREMENT**: This contract is entered in accordance with Utah Procurement Code on Sole Source Justification.

4. **CONTRACT PERIOD**: Effective date: June 1, 2005 . Termination date: December 31, 2006 , unless terminated early or extended in accordance with the terms of this Contract.

5. **CONTRACT COSTS**: CONTRACTOR will be paid a total Fixed Price of $75,000.00 for costs authorized by this Contract.

6. **ATTACHMENT A**: Standard Terms and Conditions
ATTACHMENT B: Special Terms and Conditions
ATTACHMENT C: Scope of Work including Work Plan, Staffing & Subcontracting Plan, Schedule, Contract Amount, Deliverables & Partial Payments.

Any conflicts between Attachments will be resolved first in favor of Attachment B, then Attachment A, then Attachment C.

7. **DOCUMENTS INCORPORATED INTO THIS CONTRACT BY REFERENCE BUT NOT ATTACHED**:
A. All other governmental laws, regulations or actions applicable to the goods and/or services authorized by this Contract.
B. Utah State Procurement Code and Procurement Rules.

IN WITNESS WHEREOF, the parties sign and cause this Contract to be executed.

CONTRACTOR	STATE OF UTAH
Contractor's Signature	Rukhsana Lindsey, UDOT, Division of Research
Elliot C. Kulakowski Contractor's Name	James C. McMinimee, UDOT, Project Development Group
Director, Office of Sponsored Projects Title	State of Utah, Division of Finance

Agency Contact Person:	Douglas Anderson	PIC #
Telephone Number:	(801) 965-4377	Finet Codes:
Fax Number:	(801) 965-4564	Fund: 280 Agency: 810 Org: 8214 Approp: XCC
Email Address:	dianderson@utah.gov	

Revision Date: 06/10/04

Figure B6- Contract Mod Form

STATE OF UTAH CONTRACT AMENDMENT

Amendment # _____ to Contract # _____

TO BE ATTACHED TO AND MADE A PART OF the above numbered contract by and between the following agency of the State of Utah

Department of Transportation			Research			referred to as DEPARTMENT and
Agency			**Division**			
Company Name	**Vendor Number**		**Contact Person**			
Address	**City**	**State**	**ZIP Code**		**Phone #**	

referred to as CONTRACTOR

THE PARTIES AGREE TO AMEND THE CONTRACT AS FOLLOWS:

1.	The **contract period** is amended				
	- from:		(Original starting date)		
	- to:		(New ending date)		
2.	The **dollar amount** of change to the contract for this amendment is:				$
3.	The **total contract amount** is now changed:				
	- from:	$	Fixed Amount (current contract amount)		
	- to:	$	Not-To-Exceed Amount (current contract amount +/- amendment amount)		

4. **Other changes** to the contract include:

The contract now reads:

The contract is amended to read:

5. **Effective Date of Amendment:** _____.

All other conditions and terms in the original contract remain the same.
IN WITNESS WHEREOF, the parties sign and cause this contract to be executed.

CONTRACTOR		**STATE OF UTAH**
Contractor's Signature		Rukhsana Lindsey, UDOT Research Div.
Contractor's Name		James C. McMinimee, UDOT Project Development Group
Title		Recorded by Utah St. Division of Finance

UDOT Research & Development	Fax Number	FINET Codes: Fund 280; Agency 810; Org 8214; Approp. XCC PIC #

Attachment B7- NPEP Members

New Product Evaluation Panel (NPEP)

7/28/2008

Patrick Cowley	Value Engineering/Standards
Tim Ularich	Central Maintenance
Chris Potter	Bridge Operations
Scott Dearden	Reg. 1 Materials
W. Scott Jones	Traffic & Safety
Gary Gibbs	Reg. 3 Construction
Clayton Wilson	Reg. 4 Project Management
Paul Vidmar	Reg. 2 Design
George Lukes	Central Materials
Ken Berg	Research

Attachment B8
Research Division
-Survey-

Please complete and return the following survey. This information will be used to establish "Focus Areas" for our Peer Exchange required by the FHWA.

The Peer Exchange is scheduled for September, and will include input from Transportation Research Officials from other states as well as Utah.

The survey should not take more than 3 minutes of your time.

Please rank the listed issues and initiatives in one of the following:

1- Improvement to this issue is definitely needed.
2- Improvement to this issue is somewhat needed.
3- No improvement is needed for this issue.

[ ] Research vision and mission

[ ] Research relationship with UDOT's Strategic Goals

[ ] UTRAC Workshop and Process

[ ] Outreach partnerships

[ ] Research project conduct (TACs, work plans, contracts, etc)

[ ] Research deliverables

[ ] Implementation of findings

[ ] Experimental Features Program

[ ] New Products Program

[ ] Technology Transfer Initiatives (TRIS searches, WASHTO-X, Library sessions, etc)

[ ] Library programs and activities (documents, archiving, etc)

[ ] Performance measures and program feedback

Attachment B9- UTRAC Problem Statement Form

Appendix C- Guidelines for Preparing UDOT Research Reports

1.0 INTRODUCTION

Reports communicate and store information. Reports should include all pertinent information and data used in the research, including all the background information, data and communications. Reports are designed to explain the research process and findings to interested audience. A poorly written report reflects on the research itself, whether the research was valuable or not.

This document includes guidelines for preparing reports for the Utah Department of Transportation (UDOT) Research Division. This document can be used as a template for reports.

Submitted reports will be reviewed for content, legibility, organization, and presentation. Poorly written reports will be sent back to the author for corrections.

This document is divided in the following sections:

- Introduction
- Research Report Overview
- Typographical and Visual Features of the Research Report
- Printing and Publishing
- Final Distribution
- Additional Sources and Guidance

The report writer should contact the Research Division for any clarification about these guidelines.

2.0 RESEARCH REPORT OVERVIEW

Reports should be clear and concise, providing sufficient explanation for the reader to understand the findings. Following are the report's required and optional elements, in placement order:

- Report Cover
- Disclaimer Notice
- Technical Report Documentation
- Table of Contents
- Executive Summary
- Body of Report
- Appendices (optional, as needed)
- References (optional, as needed)
- Bibliography (optional, as appropriate)
- Unit Conversion (optional, as needed)
- Acronyms (optional, as needed)

The following sections provide more details on the report's elements.

2.1 Report Cover

Draft and final reports should have a cover page conforming to the format in Appendix A and as shown in the cover page of this document. UDOT can provide the final report cover.

2.2. Disclaimer Notice

Every Research report should have a copy of Disclaimer Notice inside the front cover of the report as shown in this document and provided here:

DISCLAIMER:

> "The authors alone are responsible for the preparation and accuracy of the information, data, analysis, discussions, recommendations, and conclusions presented herein. The contents do not necessarily reflect the views, opinions, endorsements, or policies of the Utah Department of Transportation and the US Department of Transportation. The Utah Department of Transportation makes no representation or warranty of any kind, and assumes no liability therefore."

2.3 Technical Documentation

The author completes on a single sheet the Technical Report Documentation Page (also referred to as FHWA Abstract Page), according to the format template in Appendix B. The Technical Report Documentation Page includes cataloging information for use by the Federal Highway Administration (FHWA) and other libraries.

2.3 Acknowledgments

The authors may wish to acknowledge others for their involvement in the execution of the research study. The acknowledgment page should be placed right after the disclaimer notice and technical documentation.

2.4 Table of Contents

The Table of Contents should be placed right after the Disclaimer Notice or Acknowledgments. The list of figures and tables should be part or immediately follow this page. The chapters should be numbered using Arabic numerals at the left of the chapter or section title, as shown in this document. Each subsection should be divided by a period (for example Chapter 1 section 1 would be: 1.1 Title of The Section). The chapter title should be in all capital letters, bold type and underlined. Section titles have the first letters capitalized and are in bold. Subsections are underlined and have only the first letter capitalized. (Use this document as an example). The Table of Contents should be linked to the document and hyper-linked in web format.

2.5 Executive Summary

The executive summary emphasizes the results and conclusions. The executive summary should briefly summarize or refer to key information described in the report and should not be more than one or two pages long.

2.6 Body of Report

The body of the report should include at least the following sections:

- Introduction
- Research Methods
- Data Collection
- Data Evaluation/Analysis
- Conclusions
- Recommendations/Implementations

2.6.1 Introduction

In general the Introduction should include the following:

- Background information.
- Scope of the project, research, or study.
- Brief description of publications' contents.

2.6.2 Research Methods

The Research Methods section includes the subjects' detailed background, the methodologies used and other pertinent information.

2.6.3 Data Collection

This section should include information explaining how and why the data was callected for the research and where the data is available. All data should be included in one or more appendices of the report.

2.6.4 Data Evaluation

This section should include information on how and why the data was evaluated. Statistical methods employed should be listed and their use justified. Extrapolated and evaluated data should be included on tables or charts or graphs that simplify and help understand trends or other information gathered.

2.6.5 Conclusions

This section should include the researcher opinion on the research findings. The research should summarize the findings and point out the relevant data supporting the conclusions. This section should include any research limitation or challenges.

2.6.6 Recommendations and Implementation

The Recommendations are suggestions for action. The recommendations should include an Implementation Plan when applicable. The implementation plan should contain sufficient information to: a) provide direction on steps needed to implement the

technology or products developed under this contract; and b) provide recommendation on staffing needs and resources, list individuals and organizational roles and responsibilities for implementation. This section should include recommendation for further research.

2.7 Appendices

Appendices contain extensive supplementary material that is indirectly related to the report such as raw data and technical memoranda prepared in connection with the study. Brief commentary goes in a footnote. The main text has all information that is directly related to the topic.

2.8 References

The report should have a complete citation for all sources that are referred to in the text. If the author chooses to use a style that calls for a single list of references, these should be located at the end of the report unless justified for putting it elsewhere.

2.9 Bibliography

A bibliography is optional. It may be provided if there are additional useful sources that are not included in the References section. Entries should be in a uniform style, based on a standard source such as ASCE, TRB, AASHTO and NCHRP.

2.10 Copyrighted Material

Principal Investigators (authors) are responsible for securing copyright releases when using copyrighted material. The copyright releases should be provided to the Research project manager with the final report. Copyright permissions should be noted in the report.

The author will be liable for any breach in copyright laws

2.11 Unit Conversion

Measurements in UDOT reports are in the inch-pound (U.S. Customary) system. If needed the report should include a Conversion Factors Page for any units used not conforming to UDOT standard unit of measurement.

The authors may give data conversion units in parentheses for any data reported in other systems.

2.12 Acronyms

The authors should provide a list of acronyms for any abbreviations used in the report. Acronyms usually , but not always, consist of a letter or group of letters taken from the word, name or phrase.

3.0 TYPOGRPHICAL AND VISUAL FEATURES

The following sections provide information and requirements about research report typographical and visual features.

3.1 Formatting

Unless otherwise specified, research reports should follow the following format:

3.2.1 Font
The required font is Times New Romans, 12-point.

3.2.2 Line Spacing
Spacing should be uniform throughout the text of the research report. Line spacing should be 1.5, with double spacing between paragraphs.

3.2.3 Graphics
Graphics include maps, tables, figures, and photographs. Graphics should be listed in the List of Figures and List of Tables. When possible, graphics should be in color, should be designed so that they are clear and legible when reproduced in black and white. Cross-hatching, varied line forms, reverses, dots and other graphic devices can be used in addition to color to make the graphic clear. Text should be in appropriate fonts and font sizes so that graphics will be clear and easily read.

Tables, graphs, charts and other graphics must be adequately labeled to provide clear information regarding the graphic as a stand-alone piece of information compatible with the word processing software it currently uses.

Graphs and pictures should be framed.

3.2.4 Page Numbering and Order
Page numbers are horizontally centered and positioned on the bottom of the page. Page numbering begins at the Executive Summary and continues to the final page, including appendices and other background material.

3.2.5 Pagination
Reports should be printed on standard white paper measuring 8.5 inches wide by 11 inches toll. Foldout pages should be used only when necessary. Before opting for foldouts, authors should consider whether the information on a table, graph, or illustration can be formatted or designed to fit on a standard page. The project manager may choose to not accept a report that requires foldout pages.

Final reports are printed on both sides of the paper, for this reason the print master of the report may need to have blank pages interspersed to allow new chapters to begin on odd-numbered pages.

4.0 PRINTING AND PUBLISHING

The Principal Investigator should submit as many reports as required by contract (draft for review and final). All versions of the report should be submitted digitally, in a MS Word to the project manager.

The reports are reviewed for content and format. Reports should be resubmitted after being revised to the research project manager. Any revisions should follow the format outlined in this document.

5.0 FINAL DISTRIBUTION

UDOT reports are published on the UDOT Research Division web site. Paper copies are made available to: Project manager, all Technical Advisory Committee (TAC) members, the Federal Highway Administration (FHWA) Utah Division Office, the State of Utah Library System, Lester Wire Library and the Research Division Library.

An announcement of the publication with a link to the online version is made available to the AASHTO Research Advisory Council (RAC), Transportation Information Services (TRIS), State of Utah Library System and other States Departments of Transportation Libraries via email.

Electronic copies (CDs) and printed copies are available upon request. Additional distribution is subject to UDOT approval.

6.0 ADDITIONAL RESOURCES

Useful resources are the NCHRP 20-45, *"Scientific Approaches to Transportation Research*" http://onlinepubs.trb.org/onlinepubs/nchrp/cd-22/start.htm
Chapter 5—Preparing a Research Report, http://www.tfhrc.gov/qkref/qrg05.htm
The Turner-Fairbanks Highway Research Center's *Quick Reference Guide to Guidelines for Preparing FHWA Publications*. http://www.tfhrc.gov/qkref/standrd.htm and the supplements *Guidelines for Preparing Federal Highway Administration Publications*. http://www.fhwa.dot.gov/legsregs/directives/orders/h17104.htm

Attachment C1

Report Cover
Format

Report No. UT-0X.??(18 pt Arial, Bold)
This number will be assigned by UDOT at the completion of the research

TITLE (28pt Arial, All caps, Bold)

Prepared For (18 pt Arial, Bold)

Utah Department of Transportation Research Division (18 Font, Arial)

Submitted By: (18 pt Arial, Bold)

??? University (18 pt Arial)
Department of Civil & Environmental Engineering

Authored By: (18 pt Arial, Bold)

Name (s)

Date (18 pt Arial, Bold)

Attachment C2
Technical Report Documentation Page

1. Report No. UT- 0(X)-XX	2. Government Accession No. LEAVE BLANK	3. Recipient's Catalog No. LEAVE BLANK
4. Title and Subtitle TITLE IN ALL CAPITAL LETTERS Subtitle in initial capital letters		5. Report Date MONTH, YEAR 6. Performing Organization Code UTILIZE WHEN POSSIBLE
7. Author Names In Conventional Order (i.e. John A. Doe)		8. Performing Organization Report No. UTILIZE WHEN POSSIBLE
9. Performing Organization Name and Address Name Street Address City, State Zip Code		10. Work Unit No. PROJECT NUMBER 11. Contract or Grant No. CONTARCT NUMBER
12. Sponsoring Agency Name and Address Utah Department of Transportation 4501 South 2700 West Salt Lake City, Utah 84114-8410		13. Type of Report & Period Covered FINAL, INTERIM, ETC. 14. Sponsoring Agency Code PROJECT ID CODE (PIC) No.
15. Supplementary Notes Prepared in cooperation with the Utah Department of Transportation or U.S Department of Transportation, Federal Highway Administration		
16. Abstract 1. 200-250 words, A brief summary of the report		

17. Key Words Select specific and precise terms or phrases that identify principal subjects covered in the report.		18. Distribution Statement UDOT Research Division 4501 south 2700 West-box 148410 Salt Lake City, Utah 84114		23. Registrant's Seal LEAVE BLANK
19. Security Classification (of this report) Unclassified	20. Security Classification (of this page) Unclassified	21. No. of Pages Reports Page Number	22. Price LEAVE BLANK	

Appendix D- Contract Documents for Research Projects

ATTACHMENT A: Standard Terms and Conditions

A1. **AUTHORITY:** Provisions of this contract are pursuant to the authority set forth in 63-56, Utah Code Annotated, 1953, as amended, Utah State Procurement Rules (Utah Administrative Code Section R33), and related statutes which permit the DEPARTMENT to purchase certain specified services, and other approved purchases for the DEPARTMENT.

A2. **CONTRACT JURISDICTION, CHOICE OF LAW, AND VENUE:** The provisions of this contract shall be governed by the laws of the State of Utah. The parties will submit to the jurisdiction of the courts of the State of Utah for any dispute arising out of this Contract or the breach thereof. Venue shall be in Salt Lake City, in the Third Judicial District Court for Salt Lake County.

A3. **LAWS AND REGULATIONS:** Any and all supplies, services and equipment furnished will comply fully with all applicable Federal and State laws and regulations.

A4. **RECORDS ADMINISTRATION:** The CONTRACTOR shall maintain, or supervise the maintenance of all records necessary to properly account for the payments made to the CONTRACTOR for costs authorized by this contract. These records shall be retained by the CONTRACTOR for at least four years after the contract terminates, or until all audits initiated within the four years, have been completed, whichever is later. The CONTRACTOR agrees to allow State and Federal auditors, and DEPARTMENT Staff, access to all the records to this contract, for audit and inspection, and monitoring of services. Such access will be during normal business hours, or by appointment.

A5. **CONTRACTOR, AN INDEPENDENT CONTRACTOR:** The CONTRACTOR shall be an independent contractor, and as such, shall have no authorization, express or implied, to bind the DEPARTMENT to any agreements, settlements, liability, or understanding whatsoever, and agrees not to perform any acts as agent for the DEPARTMENT, except as herein expressly set forth. Compensation stated herein shall be the total amount payable to the CONTRACTOR by the DEPARTMENT. The CONTRACTOR shall be responsible for the payment of all income tax and social security amounts due as a result of payments received from the DEPARTMENT for these contract services. Persons employed by the DEPARTMENT and acting under the direction of the DEPARTMENT shall not be deemed to be employees or agents of the CONTRACTOR.

A6. **INDEMNITY CLAUSE:** Both the CONTRACTOR and the DEPARTMENT are governmental or public entities and agree to hold each other harmless for their wrongful or negligent acts or those of their employees, officers, agents or volunteers consistent with the terms and conditions of the Governmental Immunity Act and the Indemnification of Public Officers and Employees act. However, subcontracts entered into by the CONTRACTOR with other than governmental or public entities shall contain provisions requiring that the subcontractor agrees to indemnify, save harmless, and release the DEPARTMENT, and all its officers, agents, volunteers, and employees from and against any and all loss, damages, injury, liability, suits, and proceedings arising out of the performance of this contract which are caused in whole or in part by the negligence of the subcontractor's officers, agents, volunteers, or employees, but not for claims arising from the DEPARTMENT's sole negligence.

A7. **EQUAL OPPORTUNITY CLAUSE:** The CONTRACTOR agrees to abide by the provisions of Title VI and VII of the Civil Rights Act of 1964 (42USC 2000e) which prohibits discrimination against any employee or applicant for employment or any applicant or recipient of services, on the basis of race, religion, color, or national origin; and further agrees to abide by Executive Order No. 11246, as amended, which prohibits discrimination on the basis of sex; 45 CFR 90 which prohibits discrimination on the basis of age; and Section 504 of the Rehabilitation Act of 1973, or the Americans with Disabilities Act of 1990 which prohibits discrimination on the basis of disabilities. Also, the CONTRACTOR agrees to abide by Utah's Executive Order, dated March 17, 1993, which prohibits sexual harassment in the work place.

A8. **SEPARABILITY CLAUSE:** A declaration by any court, or any other binding legal source, that any provision of this contract is illegal and void shall not affect the legality and enforceability of any other provision of this contract, unless the provisions are mutually dependent.

A9. **RENEGOTIATION OR MODIFICATIONS:** This contract may be amended, modified, or supplemented only by written amendment to the contract, executed by the parties hereto, and attached to the original signed copy of the contract.

A10. **DEBARMENT:** The CONTRACTOR certifies that neither it nor its principals are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction (contract), by any governmental department or agency. If the CONTRACTOR cannot certify this statement, attach a written explanation for review by the DEPARTMENT.

A11. **TERMINATION:** Unless otherwise stated in the Special Terms and Conditions, this contract may be terminated, with cause by either party, in advance of the specified termination date, upon written notice being given by the other party. The party in violation will be given ten (10) working days after notification to correct and cease the violations, after which the contract may be terminated for cause. This contract may be terminated without cause, in advance of the specified expiration date, by either party, upon 90 days prior written notice being given the other party. On termination of this contract, all accounts and payments will be processed according to the financial arrangements set forth herein for approved services rendered to date of termination.

A12. **SALES TAX EXEMPTION:** The State of Utah's sales and use tax exemption number is E33399. The tangible personal property or services being purchased are being paid from State funds and used in the exercise of that entity's essential functions. If the items being purchased are construction materials, they will be converted into real property by employees of this government entity, unless otherwise stated in the contract.

A13. **PUBLIC INFORMATION:** The CONTRACTOR agrees that the contract will be a public document, as to distribution of copies, and Contractor gives the DEPARTMENT express permission to make copies of the contract and/or of the response to the solicitation in accordance with the State of Utah Government Records Access and Management Act. The permission to make copies as noted will take precedence over any statements of confidentiality, proprietary information, copyright information, or similar notation.

(Revision date: March 10, 2004 / UDOT Research Division A0304STATE)

ATTACHMENT B: Special Terms and Conditions

B1. CONTRACT SCHEDULE, DELAYS AND EXTENSIONS: The CONTRACTOR shall begin the work required by this contract within seven calendar days following written notification by the DEPARTMENT to proceed and shall prosecute the work diligently to the satisfaction of the DEPARTMENT and in accordance with the contract schedule (Attachment C to this contract). Completion of the contract in accordance with the schedule of Attachment C is the responsibility of the CONTRACTOR. Claims for changes in the contract schedule or extra work that may affect the contract schedule shall be submitted in accordance with the applicable provisions of this contract. Failure to comply within twenty percent of the milestone completion dates shown in the contract schedule of Attachment C constitutes adequate justification for contract termination. Upon application in writing by the CONTRACTOR, the DEPARTMENT may allow an extension of time beyond the agreed upon schedule, but by doing so does not waive any of its rights under the contract to secure full and complete contract performance.

B2. CHANGES AND EXTRA WORK: The CONTRACTOR agrees to make no charges or claims for extra compensation due to delays or hindrances within its control. The CONTRACTOR shall notify the DEPARTMENT in writing within fourteen calendar days of alleged changes to the contract due to differing site conditions, extra work, altered work beyond the scope of the contract, or actions taken by the DEPARTMENT that changed the contract Terms and Conditions. Work associated with the alleged change shall be suspended immediately and before any expenses are incurred. The written notification to the DEPARTMENT shall include the following:

(a) The date of occurrence and the nature and circumstances of the occurrence that constitute a change;
(b) Name, title and activity of each DEPARTMENT representative knowledgeable of the change;
(c) Identification of any documents and the substance of any verbal communication involved in the change;
(d) Basis for the claim that the work is not required by the contract; and,
(e) Detailed estimate of additional time and/or costs that would be incurred due to the change.

Failure of the CONTRACTOR to provide the required notice under this subsection shall constitute a waiver of any and all claims that may arise as a result of the alleged change. Following submission of the notification and in the absence of directions received to the contrary from the DEPARTMENT, the CONTRACTOR shall continue diligent prosecution of the work under the contract to the maximum extent possible without impacting conditions of the alleged change. Within 14 calendar days after receipt of notice, the DEPARTMENT shall respond in writing, either confirming or denying that a change has occurred, and advising the CONTRACTOR of the method and manner of further performance. Confirmed changes shall be followed by a negotiated written modification to the contract in accordance with the "Contract Modifications" clause of this attachment to the contract.

B3. DISPUTES: Claims by the CONTRACTOR for services, materials, or damages not clearly authorized by the contract or not ordered by the DEPARTMENT by prior written authorization in accordance with provisions herein are not binding upon the DEPARTMENT. It is specifically agreed by the parties executing this contract to use non-binding arbitration or mediation, after exhausting applicable administrative reviews, to resolve disputes arising out of this contract where the sole relief sought is monetary damages of $100,000 or less, exclusive of interest and other costs incurred outside the scope of this contract.

B4. CONTRACT MODIFICATIONS: This contract may be amended, modified, or supplemented, as it is mutually agreed to by the parties by written contract modification, executed by the parties hereto and attached to the original signed contract. Claims for services furnished by CONTRACTOR, that are not specifically authorized by this contract or by appropriate modification, shall not be paid by the DEPARTMENT.

When a contract modification has been agreed to by the parties, no claim for the extra work done or material furnished shall be made by the CONTRACTOR until the written modification has been fully executed. Any verbal agreements not confirmed in writing are non-binding.

B5. CONTRACT AMOUNT AND PAYMENT PROVISIONS: The amount due for the work performed under this contract may be based either on a fixed amount or on cost reimbursement, or both, as described in Attachment C to this contract.

When based on a fixed amount, the total contract amount due shall be paid in lump sum partial payments according to the schedule and the list of deliverables and payments contained in Attachment C to this contract, but not more than the fixed price amount of this contract and written modifications thereto.

When based on cost reimbursement, payment shall be according to actual costs for personnel, overhead, travel, and other costs incurred according to the unit costs given in Attachment C to this contract, but not-to-exceed the amount of this contract and written modifications thereto.

When the contract payment is a fixed amount, lump sum partial payments shall be based on the detailed cost estimate shown in Attachment C of this contract for the delivery of specific work items. Changes in the fixed price amount and in these lump sum partial payments can only be made through contract amendment in accordance the provisions of this contract. Actual costs that are different than the amounts shown in the detail cost estimate do not necessarily constitute a justification for a change in the fixed price amount, unless they constitute a change in scope, differing site conditions, etc. in accordance with the above referenced contract provisions.

When the contract payment is by cost reimbursement, the total not-to-exceed contract amount shall be based on the detail cost estimates and unit prices shown in Attachment C of this contract. However, payment shall be for actual costs incurred for any given line item in the estimate, billed at the unit prices described in Attachment C. Justification will be required for each cost item. In the case of personnel hours, the justification will be written approval by the DEPARTMENT for the amount of that line item prior to commencing work on that item. In the case of other expenditures, the justification shall consist of copies of receipts by the suppliers of the products or services being reimbursed. Overhead and profit, if applicable, shall be applied as a rate to other cost items as shown in Attachment C. Also, actual costs for any given line item in the estimate shall not exceed the budget amount by more than 25 percent without prior written approval from the DEPARTMENT.

Invoices for payment of either lump sum or cost reimbursement partial payments shall be prepared and submitted in accordance with the outline described below and with the contract amount and basis of payment given in Attachment C to this contract. As a minimum, the invoice shall list the name of the CONTRACTOR, the DEPARTMENT Contract Number, the invoice date and the remittance address. Also, the invoices shall list the deliverable item number from the List of Deliverables shown in Attachment C, its description, the payment basis and the actual partial payment amount due. Invoices for cost reimbursement deliverables shall itemize each cost entry, showing the units, the unit costs and the total amount of each item. In addition, invoices shall be accompanied by a progress report and specified deliverables listed in Attachment C. Invoices that do not meet these requirements shall not be considered responsive.

Invoices for partial payments shall be submitted upon delivery of each item listed in the List of Deliverables shown in Attachment C, but not more often than monthly. Invoices and progress reports shall be submitted to the DEPARTMENT'S Technical Representative listed in the "Notices" clause in this contract.

The DEPARTMENT shall process invoices for payment within thirty (30) days after receipt. However, the DEPARTMENT, at its sole discretion and after giving the CONTRACTOR written notification, may delay payment of invoices that are disputed or that are submitted without the specified forms, reports and deliverables.

In the event that the contract is terminated prior to completion of the work, the DEPARTMENT shall pay CONTRACTOR for products and services actually completed, including documented work in progress, at

the lump sum amounts or unit prices established in the Contract, as set forth in Utah State Procurement Rules and DEPARTMENT Policy. Lump sum amounts may be prorated.

B6. LOBBYING RESTRICTIONS: The CONTRACTOR agrees to conform with the lobbying restrictions established by Section 319 of Public Law 101-121 (31USC 1352) and 49USC 322(a) for contracts exceeding $100,000 in Federal Funds. Certificates of disclosure conforming to law shall be provided by the CONTRACTOR when required.

B7. THIRD PARTY BENEFICIARY: It is specifically agreed between the parties executing this contract that it is not intended by these contract provisions to create in the public or any member thereof a third party beneficiary hereunder, or to authorize anyone not a party to this contract to maintain a suit for personal injuries or property damage pursuant to the contract.

B8. PERSONNEL REQUIREMENTS & KEY PERSONNEL: All officers, agents, volunteers, or employees of the CONTRACTOR or any of its subcontractors that are assigned to perform work under this contract shall have the proper training, skill, experience and licenses to meet acceptable standards of performance and as required by law. The key personnel identified in the Staffing and Subcontracting Plan (Attachment C to this contract) shall be in responsible charge of the work during the entire term of this contract. Any change in personnel from that specifically identified in the Staffing and Subcontracting Plan shall be subject to prior written approval by the DEPARTMENT.

If at any time during the duration of this contract officers, agents, volunteers, or employees of the CONTRACTOR or any of its subcontractors that are performing work under this contract fail to demonstrate the required expertise represented in the staffing and subcontracting plan (Attachment C to this contract), fail to perform the work in a professional and skillful manner or fail to retain licenses required by law, then the CONTRACTOR shall remove such person or persons from the work. If, upon the written request of the DEPARTMENT, the CONTRACTOR or its subcontractors fail to remove such person or persons or fail to furnish skilled and experienced personnel for the proper performance of the work, the DEPARTMENT may terminate this contract with cause in accordance with the termination provisions of this contract.

B9. ASSIGNMENT AND SUBCONTRACTING: The CONTRACTOR shall not subcontract any of the work required by this contract, or assign monies to be paid to the CONTRACTOR hereunder unless specifically authorized in writing by the DEPARTMENT. Also, unless specifically authorized in writing by the DEPARTMENT, the CONTRACTOR shall perform work valued at not less than 70% of the total contract amount with its own staff. All subcontractors shall be as identified in the staffing plan of Attachment C. All payments made by the CONTRACTOR to the subcontractor for services required by this contract shall be subject to audit by the DEPARTMENT.

All subcontracts at any tier must include the same terms, conditions and provisions included in this contract. However, the CONTRACTOR shall be responsible for ensuring that all work performed by subcontractors are insured under the CONTRACTOR's insurance policy, or subcontractors shall be required to meet the same insurance provisions required under this contract.

B10. EMPLOYMENT OF DEPARTMENT EMPLOYEES: The CONSULTANT agrees not to engage in any way the services on this contract of any present or former DEPARTMENT employee who was involved as a decision maker in the selection or approval processes or who negotiated and/or approved billings or contract modifications for this contract.

B11. USE OF PATENTED, COPYRIGHTED OR TRADEMARKED ITEMS: The CONTRACTOR shall be fully responsible for the legal use and the related payment of any royalties or fees for any materials, products, devices, processes, computer elements, designs, specifications, publications, graphics, visual media, etc., that are protected by patents, copyrights or trademarks, or that are owned by third parties to this contract, in conjunction with the execution of the work in this agreement. In the event that any of the above items are to be incorporated into the deliverables or products which will be provided to the DEPARTMENT as a result of the work of this agreement, whether owned by the CONTRACTOR before entering into this agreement or not, such use shall be specifically authorized in this contract or by prior written approval from the DEPARTMENT. When such authorization is provided, the CONTRACTOR

shall secure the rights of use of these patented, copyrighted or trademarked items for the DEPARTMENT. An original executed copy of the right-to-use agreement shall be delivered to and approved by the DEPARTMENT prior to commencing use of these item(s). The CONTRACTOR shall be responsible for payment of all royalties and fees for said use during the entire term of this contract. To the extent that these royalties and fees are incurred exclusively and specifically for this contract and are shown in Attachment C, these costs are allowable expenses to the contract. The CONTRACTOR and their surety shall indemnify, save harmless and release the DEPARTMENT from any and all claims of patent, copyright or trademark infringement, or for costs, expenses, penalties and damages that may be obligated by reason of an infringement related to the work performed, services rendered or deliverables furnished under this contract which are caused in whole or in part by the negligence of the CONTRACTOR. When Federal funds make up all or part of the remuneration under this contract, the United States Department of Transportation shall be named along with the DEPARTMENT in all legal agreements covering use of patented, copyrighted or trademarked items.

B12. CONFIDENTIALITY: If, in order to perform the work under this contract, the CONTRACTOR is given access to confidential or proprietary business, technical or financial information regarding persons, materials, products, devices, processes, designs, computer elements, analyses, data, etc., the CONTRACTOR agrees to treat such information as confidential and shall not appropriate such information to its own use or disclose it to third parties at any time, neither during the term of this contract nor after contract termination, without specific written authorization by the DEPARTMENT to do so. The DEPARTMENT shall clearly identify those items as confidential at the time they are transmitted or disclosed to the CONTRACTOR. The CONTRACTOR shall require adherence by its officers, agents, volunteers, employees and subcontractors to these confidentiality provisions.

The foregoing obligations shall not apply if the said confidential or proprietary information:

(a) Is found to be in the public domain at the time of receipt by the CONTRACTOR;
(b) Is published or otherwise becomes part of the public domain after receipt by and through no fault of the CONTRACTOR;
(c) Was in possession of the CONTRACTOR at the time of receipt, which the CONTRACTOR can demonstrate, as well as that it was not acquired directly or indirectly from the DEPARTMENT or an agency of the State of Utah; or
(d) Was received by the CONTRACTOR from a third party other than an agency of the State of Utah, which the CONTRACTOR can demonstrate did not require the CONTRACTOR to hold such information in confidence.

B13. OWNERSHIP OF WORK PRODUCTS PROCURED OR DEVELOPED UNDER THIS CONTRACT: Unless specifically designated hereinafter, the DEPARTMENT retains ownership of all materials, products, devices, equipment, facilities, data, test results, reports, graphics, presentations, visual aids, computer elements, software (including source code), software license agreements, testing apparatus, services, etc., that are developed, procured, constructed, installed or performed under this contract and that become an integral part of or that are intended to facilitate or enhance the use, operation, maintenance, documentation or understanding of the deliverables of this contract. In addition, the DEPARTMENT shall retain ownership of all non-expendable items procured under this contract that have a salvage value at the end of this contract of $5,000.00 or more.

The DEPARTMENT grants to the CONTRACTOR a non-exclusive license for non-commercial, internal, educational and research use of work products developed or produced by the CONTRACTOR under this contract, subject to the provisions of this contract. The use of physical products is subject to availability. Physical products will be transported and maintained at the expense of the CONTRACTOR, should transportation and maintenance be necessary in conjunction with this use.

The CONTRACTOR may secure through patents or trademarks, the right, title, or interest throughout the world of any invention that may be created or developed under this contract, as provided in 37 CFR 401.14, except for Section 401.14(g). The DEPARTMENT shall be entitled to the same rights granted to the Federal Government under 37 CFR 401.14 and adopts that regulation for that purpose. The CONTRACTOR will retain all rights provided for the DEPARTMENT in this clause, and the

DEPARTMENT will not, as part of the consideration for awarding this contract, obtain rights in the CONTRACTOR'S subject inventions. The DEPARTMENT shall be granted a non-exclusive, irrevocable, royalty-free license to use, practice, employ, or have practiced for or on behalf of the DEPARTMENT the subject invention throughout the world. These license provisions shall be considered one of the deliverables due under this contract. When federal transportation funds make up all or part of the remuneration under this contract (as documented elsewhere in these Special Provisions), the United States Department of Transportation shall also be named as a grantee, along with the DEPARTMENT, in the license provisions described above.

The CONTRACTOR may secure copyrights on information, designs, analyses, processes, reports, and the intellectual innovations that may be created or developed under this contract, subject to the provisions of this contract, including the provisions of the "Publication or Use of Work Product Outside of This Agreement" clause.

The DEPARTMENT reserves a non-exclusive, irrevocable, royalty-free license to reproduce, publish, distribute, disclose, modify, implement, or otherwise use, and to authorize others to use, the copyright in any work developed under this contract, and any rights of copyright to which the CONTRACTOR purchases ownership with the support of this contract.

The right of the CONTRACTOR to apply for patents, copyrights or trademarks shall be limited to the statutory period defined by United States Code and other applicable Federal regulations.

It is further specifically agreed between the parties executing this contract that the above provisions shall be interpreted and administered in accordance with State and Federal non-disclosure and disclosure laws, rules, regulations and policies governing patents, copyrights, trademarks, rights of privacy and freedom of public information.

Full scale testing frames, anchors and related testing or measuring devices built or acquired as part of this contract shall be the property of the CONTRACTOR upon the completion of the contract.

B14. RIGHT OF FUTURE DEVELOPMENT: Both parties agree that the DEPARTMENT and third parties that may be under separate contract to the DEPARTMENT may perform future additional developments or enhancements to information, designs, analyses, computer elements, devices, data, test results, reports, graphics, presentations, visual aids, intellectual innovations that are derived from the work products developed and delivered under this contract. The DEPARTMENT shall not be obligated to obtain the services of the CONTRACTOR to perform these additional developments or enhancements. Likewise, the CONTRACTOR, after completion of this contract, may perform future additional developments or enhancements to the work products produced and delivered under this contract without the necessity of granting the DEPARTMENT a license of use for these additional developments or enhancements.

B15. PUBLICATION OR USE OF WORK PRODUCT OUTSIDE OF THIS AGREEMENT: During the entire term of this contract the CONTRACTOR shall not issue, offer, publish, or submit for publication any document, report, paper, technical notes, documentation, specification, graphic, or other media products produced in connection with the work of this contract without first submitting the deliverables required by this contract to the DEPARTMENT for their review, and notifying the DEPARTMENT of the intent to publish.

In the event CONTRACTOR wishes to publish research results prior to the submission of contract deliverables, CONTRACTOR shall first provide to DEPARTMENT written notice of CONTRACTOR's intent to publish and a draft of such publication. DEPARTMENT shall have thirty (30) days after receipt of the draft publication to request in writing the removal of portions deemed by DEPARTMENT to contain confidential or patentable material owned by DEPARTMENT, or to request a delay in submission of the draft for publication pending CONTRACTOR's submission of overdue contract deliverables or DEPARTMENT's application for patent protection. If CONTRACTOR does not receive DEPARTMENT's written response to the notice of intent to publish within the thirty (30) day period, then DEPARTMENT shall be deemed to have consented to such publication. If DEPARTMENT requests a delay in submission of publication for patent protection, CONTRACTOR shall have no obligation to delay publication for longer than three (3) months following delivery of CONTRACTOR's notice of intent to publish. If

DEPARTMENT requests a delay in submission of publication due to overdue deliverables, submission of publication by the CONTRACTOR prior to completing those contract deliverables shall be grounds for termination of this Agreement. Student reports, theses, and dissertations, published internally by the CONTRACTOR shall not be subject to these delay provisions.

If this Agreement is terminated by the DEPARTMENT for non-performance or failure to meet project deliverable dates, the CONTRACTOR agrees to the publication restrictions stated above for a period of six (6) months following the date of termination.

Information supplied to CONTRACTOR by DEPARTMENT and identified by DEPARTMENT as proprietary information shall not be included in any material published by CONTRACTOR without prior written consent of DEPARTMENT.

All documents resulting from the work of this contract by the CONTRACTOR, regardless of the time when they are created, produced, or released, shall contain acknowledgement and disclaimer statements as stipulated in the "Acknowledgements and Disclaimers" clause in this contract.

The restrictions and procedures described above shall apply to the release of any information or documents to the media. The UDOT Public Affairs Office shall be informed of all media inquiries.

Requests from the media or other members of the public for records that have not already been issued, published, or submitted for publication shall be made in accordance with the Governmental Records Access and Management Act (GRAMA), Title 63, Chapter 2, Utah Code Annotated.

B16. ACKNOWLEDGEMENTS AND DISCLAIMERS: Any document, report, paper, technical notes, documentation, specification, computer element, graphic, media element, or other deliverable that is prepared or released by the CONTRACTOR shall contain an acknowledgement of support by the DEPARTMENT. When federal transportation funds make up all or part of the remuneration under this contract (as documented elsewhere in these Special Provisions), the United States Department of Transportation shall also be acknowledged as a supporter of the work. In addition, any of these deliverables shall contain the following disclaimer:

> "The authors alone are responsible for the preparation and accuracy of the information, data, analysis, discussions, recommendations, and conclusions presented herein. The contents do not necessarily reflect the views, opinions, endorsements, or policies of the Utah Department of Transportation or the US Department of Transportation. The Utah Department of Transportation makes no representation or warranty of any kind, and assumes no liability therefore. "

B17. INSPECTION AND REVIEW: It is agreed that authorized representatives of the DEPARTMENT and other third parties designated by the DEPARTMENT shall have the right to inspect and review the work in progress at any time during normal business hours or by appointment.

All deliverables furnished under this contract shall be subject to the inspection and review of the DEPARTMENT and other third parties designated by the DEPARTMENT to perform technical or fiscal inspections or reviews. The CONTRACTOR shall be required to perform such work as may be necessary to meet the objectives of the work plan (Attachment C to this contract) and to make clarifications or correct errors uncovered during reviews or inspections without undue delays and without additional cost to the DEPARTMENT.

B18. PROGRESS AND PROGRESS REPORTS: In addition to the other deliverables (Attachment C to this contract), the CONTRACTOR shall prepare fiscal and technical progress reports following the format established by the DEPARTMENT and in sufficient detail to document the progress of the work and to support the claim for payment. As a minimum the progress reports shall identify the deliverables completed, for which payment requests are being made, a brief summary of the work completed to date, a brief synopsis of the deliverable contents, and the invoice number of the payment request. Anticipated problems in completing future deliverables in accordance with the technical and schedule requirements of

the contract shall be identified if applicable and the background behind them. Payments will not be made without a supporting progress report.

B19. MEETINGS/CONFERENCES: Progress and review meetings/conferences will be held as required and not less than at quarterly intervals. Either party may request a meeting/conference. If requested by the DEPARTMENT, the CONTRACTOR shall prepare and distribute documentation that demonstrates the progress and features of the work and/or the deliverables to be reviewed. The CONTRACTOR shall distribute copies (not to exceed 20) of this documentation to the list of attendees/reviewers designated by the DEPARTMENT at least seven days prior to the meeting, or as otherwise agreed.

The CONTRACTOR shall prepare meeting/conference minutes following the format established by the DEPARTMENT and in sufficient detail to document the date, time, location and persons attending the conference, a summary of presentations made, review comments received, and action items agreed to. In the case that designated attendees/reviewers do not attend the meeting/conference but submit written comments prior to the meeting/conference, copies of these comments shall be attached to the minutes. The CONTRACTOR shall distribute copies of the minutes to the attendees/reviewers within seven calendar days of the meeting/conference, requesting comments or suggestions for modifications to be returned to the CONTRACTOR within seven calendar days. If any comments or suggestions for modifications received during this period, the CONTRACTOR shall issue AN ERRATUM to the minutes within 14 calendar days of the meeting/conference.

B20. REPORTS, DOCUMENTATION AND OTHER MEDIA PRODUCTS: Progress, interim and final reports, white papers, technical notes, presentations and other documentation and media products produced as deliverables under this contract shall conform to the highest standards for literary style, grammar, spelling, graphic art and technical accuracy. They shall be subject to review by the DEPARTMENT, its representatives and agents, as well as other funding agencies and partners, prior to publication and distribution. If the documentation contains contributions by the DEPARTMENT or third parties, these entities shall be fully acknowledged in the documentation. Except where acknowledged otherwise, the CONTRACTOR shall be solely responsible and liable for the accuracy, completeness and originality of the contents, findings and conclusions. The responsible person(s) or principal investigator(s) for the CONTRACTOR listed in Staffing Plan (Attachment C to this contract) shall be the primary author(s) of the documentation.

The above described documentation shall not contain advertisements or attempts to promote materials, equipment, products or services supplied by or the special interests of the CONTRACTOR or third parties to this contract. The documentation shall be free of libel or slander relating to individuals, organizations and groups or their materials, equipment, products or services.

Interim reports, when required, shall be concise and focused on the specified aspects of the work. They may be submitted in draft form. They are expected to form a component of the draft final report. They are intended for review by the DEPARTMENT and other sponsoring entities and not for publication. Review comments received from the DEPARTMENT, either written or in conference, shall be addressed by the CONTRACTOR in the final report. The interim reports need not be reissued with corrections addressing these comments.

The CONTRACTOR shall submit a final report that summarizes the detailed research findings of study, including the data collection plan, the methodology used in and the results obtained from the detailed data reduction, the results of analysis and the comparisons with existing theories and findings of other researchers in the field. The final report shall also summarize the contents of any interim reports furnished as well as provide a background for the subject matter and the justification for funding the research. It shall include comparisons with current design practice and recommendations for implementation of the findings, as well as conclusions and acknowledgments. Abstracts of no more than 250 words and executive summaries of no more than 12 pages shall be developed that provide synopses of the final report. The final report shall be submitted in draft form, for review, and then in final form, for publication. Review comments received from the DEPARTMENT, either written or in conference, based on a review of the draft final report or presentation of the material contained therein, shall be addressed by the CONTRACTOR in the final version of the final report. The final report shall be a complete, stand-alone document intended for hard copy, electronic, and/or web publication by the DEPARTMENT.

Reports intended for publication by the DEPARTMENT shall include the following minimum elements:

- Standard UDOT/FHWA title and abstract pages;
- Table of contents;
- List of Figures and Tables;
- Executive Summary;
- Body of report;
- Implementation Plan and/or recommendations;
- Acknowledgments;
- List of References; and
- Appendices.

The body of reports intended for publication shall summarize the subject matter in sufficient detail to support the recommendations and conclusions. Charts, graphs, figures, tables, illustrations and photographs shall be used extensively to enhance communication. Graphs and tables are to be neat in appearance with each axis clearly marked with proper units. A legend is to be provided on every graph that clearly describes acronyms and other symbols. Graphical element patterns and symbols should be carefully chosen to ensure legibility after reproduction. Raw data, detailed analysis and theoretical developments shall be contained in appendices.

The Implementation Plan should contain sufficient information to: a) provide direction on steps needed to implement the technology or products developed under this contract; b) provide recommendation on staffing needs and resources, list individuals and organizational roles and responsibilities for implementation; and c) provide estimated cost of implementation. Technologies or products could include any of the following, but not limited to: written specifications; policies and procedures; newsletters; research technical reports; training sessions; laboratory testing results; workshops, and technology demonstrations. If the technology or products are not developed to a state of implementation, specific recommendations should be provided on what is needed to bring it to such a state.

References to other documents containing the raw data, detailed analysis or theoretical developments may be cited to avoid repetition, providing these documents are published prior to the subject reports. If references are used, a sufficient summarization shall be included in the reports to communicate both the findings and conclusions of the authors cited and their significance to the recommendations and conclusions of the subject reports. Also, full bibliographic acknowledgments shall be made for all references cited.

Reports intended for publication by the DEPARTMENT shall conform to the format criteria established by the DEPARTMENT. Five (5) copies of the draft version shall be submitted to the DEPARTMENT for review. After all review comments are considered and corrections are made by the CONTRACTOR, one (1) original, final copy of the report suitable for photocopying shall be delivered to the DEPARTMENT, along with a full and complete, unprotected electronic copy. If the final draft version is over 50 pages, the report shall be formatted for double-sided reproduction and/or printing.

Unless otherwise approved in writing by the DEPARTMENT, electronic versions of documents or work products required to be delivered under this contract shall be produced in the file formats native to the computer applications adopted as standard by the DEPARTMENT. The electronic delivery media, as well as photographic, audio and video deliverables shall conform to the format established by the DEPARTMENT.

The reports required under this contract are intended to be summary in nature. In addition to the report to be published by the DEPARTMENT as outlined above, it is anticipated that detailed aspects of the work performed under this contract may be published by others (thesis, journal articles, etc), subject to notification to and review by the DEPARTMENT as described in the "Publication or Use of Work Product Outside of This Agreement" clause in this contract.

B21. SYSTEM OF MEASUREMENT: Written and electronic documentation and reports prepared under this contract shall use U.S. Customary systems of measurement.

B22. REQUIREMENTS FOR COMPUTER ELEMENTS: Hardware, firmware and/or software elements that the CONTRACTOR procures, furnishes, licenses, sells, integrates, creates and/or enhances for the DEPARTMENT under this contract shall achieve the specific objectives specified in the work plan (Attachment C to this contract). These elements shall be free of defects, or "bugs," that would prevent them from achieving the objectives specified in the work plan. Computer software and applications created and/or enhanced under this contract shall include as deliverables user instructions, program documentation, program listings, source code and specified format specific compiled files. The program documentation shall include flow charts and detailed treatment of decision algorithms and their technical basis.

Software development and operating system platforms shall be approved by the DEPARTMENT and specified in the Work Plan (Attachment C to this contract). Changes to these platforms shall only be allowed by written authorization by the DEPARTMENT. Software licenses that are provided by the DEPARTMENT for use by the CONTRACTOR to perform work under this contract are limited to the term of this contract. During the term of this contract the CONTRACTOR shall protect the licensed software programs, media, operating instructions and documentation from theft or loss. Use of this licensed software shall be limited to the work under this contract. At the end of the contract, all such licenses shall be terminated and the software removed from the CONTRACTOR's equipment. Also, at that time the software programs, media, operating instructions and documentation furnished with the license shall be returned to the DEPARTMENT.

B23. HEALTH AND SAFETY REQUIREMENTS: The CONTRACTOR shall do all work necessary to assure safety and be solely and completely responsible for conditions at the work site, whether field, laboratory or office, including safety of all persons and property during the length of the contract. The requirement shall apply continuously for the duration of the contract and shall not be limited to normal business hours or other time constraints. The CONTRACTOR is fully responsible for the prevention of accidents to workers engaged upon or in the vicinity of the work and the protection of the public.

The CONTRACTOR shall bear the primary responsibility for compliance with all applicable standards, regulations and requirements of the Utah Division of Occupational Safety and Health, the Federal Occupational Safety and Health and Mine Safety Health Administrations, the DEPARTMENT's current safety manual, as well as rules and regulations of Federal, State and local health officials regarding the health and safety of the CONTRACTOR's and the DEPARTMENT's officers, agents, volunteers, or employees, and the public in general. Upon verbal or written notification of any deficiencies or failures to comply with the standards and regulations specified above that is given by any governing agency or by the DEPARTMENT, the CONTRACTOR shall immediately correct the deficiencies or causes of noncompliance. The DEPARTMENT at its sole discretion may issue a stop work order effective beginning immediately upon verbal notification by a representative of the DEPARTMENT and continuing in effect until a start work authorization is issued by the DEPARTMENT. Written confirmation outlining the justification of the stop work order shall be issued by the DEPARTMENT within two calendar days of verbal notification. Failure to abide by this stop work order or to meet any of the above requirements or to correct the noted deficiencies are grounds for contract termination. Also, the CONTRACTOR shall be liable for any costs, delays, damages, assessment of penalties and fees resulting from or in connection with stop work orders and the correction of health or safety deficiencies or causes of noncompliance.

The CONTRACTOR shall comply with applicable Federal, State, county and local fire prevention regulations and execute all work in a fire-safe manner. The CONTRACTOR shall supply and maintain on the site adequate fire-fighting equipment capable of extinguishing incipient fires.

If the handling, use, or storage of explosives or other hazardous materials or equipment is necessary for the execution of the work, the CONTRACTOR shall exercise the utmost care to protect people and property and shall carry on such activities only under the direct supervision of properly trained and qualified personnel and in strict compliance with applicable laws, codes, or regulations.

It shall be the responsibility of the CONTRACTOR to maintain the work site so as to be free from recognizable hazards that could cause or would be likely to cause injury to the CONTRACTOR's personnel, the general public, or the DEPARTMENT's staff and property damage or loss to this and other sites at or adjacent to the work being performed herein. The CONTRACTOR shall maintain at the work

site safety equipment as appropriate for the work as prescribed in applicable governmental rules, as well as all articles necessary for giving first aid to the injured.

B24. ENVIRONMENTAL PROTECTION: The CONTRACTOR shall comply with all applicable standards, regulations and requirements of the State of Utah, Department of Environmental Quality, the Federal Environmental Protection Agency, the U.S. Army Corps of Engineers, as well as that of other Federal, State and local environmental officials regarding protection of the environment. Upon verbal or written notification of any deficiencies or failures to comply with the standards, regulations and requirements specified above that is given by any governing agency or by the DEPARTMENT, the CONTRACTOR shall immediately correct the deficiencies or causes of noncompliance. Failure to meet any of the above requirements or correct noted deficiencies is grounds for contract termination.

B25. PROTECTION AND RESTORATION OF PROPERTY: Public and private property shall be preserved in the performance of the work under this contract. The CONTRACTOR shall be held responsible for damage or injury to public or private property resulting from any act, omission, neglect, or misconduct in the method of executing the work, or due to defective work or materials. The CONTRACTOR shall restore all damaged or injured property to a condition similar or equal to that existing before the damage or injury occurred at no additional cost to the DEPARTMENT.

B26. INSURANCE: For all work provided under this contract, the CONTRACTOR and its subcontractors of all tiers shall maintain their own insurance of the types and with the limits as set forth hereinafter at their own expense, with coverage that recognizes the DEPARTMENT'S Project Sites. CONTRACTOR shall promptly furnish the DEPARTMENT, or its designated representative, certificates of insurance giving evidence that all required insurance is in force. Specific requirements for certificates of insurance shall be as delineated hereafter. All insurance shall be kept in force through the entire duration of the Work.

(a) Insurance Types and Limits:

(1) Workers Compensation:
CONTRACTOR/ subcontractors shall provide, at their own expense, Workers' Compensation Insurance to cover full liability under the Workers' Compensation Laws of the jurisdiction in which the Project is located at the statutory limits required by said jurisdiction's laws.

CONTRACTORS or subcontractors of all tiers that are departments, agencies, educational institutions, foundations or other entities of the State of Utah shall obtain certificates for Workers' Compensation Insurance underwritten by the Worker's Compensation Fund of Utah or other State of Utah sponsored insurance carriers.

(2) Commercial General Liability:
CONTRACTOR/subcontractors shall provide, at their own expense, Commercial General Liability Insurance, on an "occurrence basis", including insurance for premises and operations, independent contractors, products/completed operations, and contractual liability specifically designating the Indemnity provisions of this Contract Agreement as an insured contract on the Certificate of Insurance. Such Commercial General Liability Insurance must afford coverage for explosion, collapse, and underground hazards. The insurance required by this paragraph should be in limits not less than the following:

$2,000,000	General Aggregate
$1,000,000	Products-Completed Operations Aggregate
$1,000,000	Personal & Advertising Injury
$1,000,000	Each Occurrence
$ 50,000	Fire Damage (Any one fire)
$ 5,000	Medical Expense (Any one person)

(3) Automobile Liability:
CONTRACTOR shall provide, at their own expense, Automobile Liability Insurance for claims arising from the ownership, maintenance, or use of a motor vehicle at, upon, or away from the Project Site.

The insurance shall cover all owned, non-owned, and hired automobiles used in connection with the Work, with the following minimum limits of liability:

$1,000,000 Combined Single Limit Bodily Injury and Property Damage Per Occurrence

(b) Certificates of Insurance:

Upon execution of the contract and before issuance of a Notice to Proceed and prior to entrance onto the Project Site, the CONTRACTOR and its subcontractors of all tiers shall provide to the DEPARTMENT a Certificate of Insurance setting out coverages, limits and amendments to the certificate necessitated by changes to the work to be performed under the contract until the date of final payment. Said certificate shall state that the policies required have been endorsed to provide that the insurers issuing said policies shall give the DEPARTMENT not less than thirty (30) days prior written notice in the event of cancellation. Any coverage written on a claims-made basis shall be indicated as such on the certificate of insurance. And, except for CONTRACTORS or subcontractors of all tiers that are departments, agencies, educational institutions, foundations or other entities of the State of Utah, said certificates shall state that all policies required have been endorsed to name the State of Utah and the DEPARTMENT as Additional Insureds. Certificates shall be in a form and content satisfactory to the DEPARTMENT. CONTRACTORS or subcontractors of all tiers that are departments, agencies, educational institutions, foundations or other entities of the State of Utah shall obtain certificates for the required insurance from the State of Utah Risk Manager.

All insurance described in this contract shall be written by an insurance company or companies authorized to do business in Utah and satisfactory to the DEPARTMENT. No party subject to the provisions of this contract shall violate or knowingly permit to be violated any of the provisions of the policies of insurance described herein. All insurance should be provided by insurance companies with a Best's rating "A- VIII" or better or with the Utah State Risk Management Fund.

All insurance policies shall be primary and non-contributing with, and not in excess of, any other insurance available to the DEPARTMENT.

(c) Other Insurance:

Any type of insurance or any increase of limits of liability not described herein that the CONTRACTOR requires for its own protection or on account of any statute shall be its own responsibility and at its own expense. Each CONTRACTOR and all subcontractors have the responsibility to make sure that their insurance programs fit their particular needs, and it is their responsibility to arrange for and secure any insurance coverage, which they deem advisable, whether or not specified above.

(d) No Release:

The carrying of the above-described insurance shall in no way be interpreted as relieving the CONTRACTOR or subcontractors of any other responsibility or liability under this agreement or any applicable law, statute, regulation or order.

B27. DUTIES OF THE DEPARTMENT: The DEPARTMENT shall give prompt consideration to all reports, plans, proposals, notices, notifications of intent to publish, invoices, and other documents presented by the CONTRACTOR.

B28. PRE-AWARD SPENDING AUTHORIZATION: Due to the time constraints associated with this contract, pre-award spending by the CONTRACTOR is authorized for initial work items prior to final work plan development and formal execution of contract documents.

B29. NOTICES: Legal notices applicable under this contract shall be in writing and shall be delivered by certified mail to the following designated individuals for the CONTRACTOR and the DEPARTMENT, with a copy sent to the technical representative designated below:

- CONTRACTOR'S Contract Representative:
  Name & address

Bus. Phone:
Bus. Fax:

- DEPARTMENT'S Contract Representative:
  Ms. Shauna Sisneros
  Utah Department of Transportation Comptroller's Office
  Box 141510
  Salt Lake City, UT 84114
  Bus. Phone: (801) 965-4541
  Bus. Fax: (801) 965-4911
  Email: ssisneros@utah.gov

Technical representatives for the CONTRACTOR and the DEPARTMENT that are to receive or respond to technical questions or comments, deliverables, reviews, and other non-legal correspondence except invoices are as follows:

- CONTRACTOR'S Technical Representative:
  Name & address
  Bus. Phone:
  Bus. Fax:
  E-mail:

- DEPARTMENT'S Technical Representative:
  Project Manager
  UDOT Research Division
  P.O. Box 148410
  Salt Lake City, UT 84114-8410
  Bus. Phone:
  Bus. Fax: (801) 965-4564
  E-mail:

ATTACHMENT C: Scope of Work & Detailed Work Plan

(See Section 3.5)

Appendix E- UTRAC Workshop History

UTRAC Workshop History

Date	Location	Trailblazer Award	Keynote Address
2008 - 4/15	SLCC L.Miller Conf Center	Chris Pantelides, UofU	Jim McMinimee, UDOT
2007 - 3/6	SLCC L.Miller Conf Center	Les Youd, BYU	Paul Tikalski, UofU
2006 - 3/21	SLCC L.Miller Conf Center	Larry Reaveley, UofU	John Njord, UDOT
2005 - 3/3	U of U – Ft Douglas	Stan Burns, UDOT	Carlos Braceras, UDOT
2004	Not held (Held Implementation Symposium instead, at R2 Hurley)		
2003 - 3/20	UDOT R2 – Hurley CR	Jim McMinimee, UDOT	None
2002 - 3/20	BYU	Doug Anderson, UDOT	Loren Anderson, USU
2001 - 3/14	BYU	Loren Anderson, USU	John Leonard, UDOT (re: I-15 Reconstruction)
2000 - 3/14&15	U of U	Tom Warne, UDOT	Tom Warne, UDOT
1999 - 3/17&18	U of U	John Gunderson, UDOT	Tom Warne, UDOT
1998 - 3/18&19	USU	William Grenney, USU	Suzanne Winters, Governor's Science Advisor
1997 - 3/12&13 (5^{th} Annual)	USU	Doyt Bolling, USU T^2	John Baxter, FHWA (Asst Div Admin)
1996 - 3/12&13	USU	Dale Peterson, UDOT	Clint Topham, UDOT (Deputy Director)
1995 - 3/14&15	USU	Howard Richardson, UDOT	Charles Nemmers, FHWA (Turner-Fairbanks Research)
1994 - 3/16&17	USU	Wade Betenson, UDOT	None
1993 – 5/19&20	USU	None	None

Appendix F- Examples of Political Decisions

Pervious Concrete was proposed by a well-respected vendor following a great deal of public display. Newspaper articles and other media events were distributed on the product. This paving material was advertised to eliminate hydroplaning by allowing moisture to travel through the pervious pavement into the subgrade.

Freeze-thaw testing was done on samples of the material in the UDOT Central Lab. The samples were reduced to gravel by the testing. The UDOT Director firmly rejected using the material in Utah.

Syncrete is a product that provided a thin-bonded overlay for the product to rehabilitate rigid pavement. A very influential vendor with influential Utah investors submitted the product for testing through the Department's New Product Evaluation Program. Three small test sections were placed in Utah, one in California, and one on the University of Utah campus. All test sections began to de-bond from the underlying surface during the second winter.

Investors with the vendor approached the governor to determine why UDOT had not agreed to use the product. Political figures within UDOT and from outside of the Department funded a large, high profile project on I-15 near downtown SLC. The product began to debond from the concrete surface before the contractor was completed with the job. A great deal of expense to remove the product, traffic delays, and many broken windshields were the result.

BIBLIOGRAPHY

"Guide for Developing a State Transportation Research Manual", FHWA, April 1997

"Utah Department of Transportation Research Manual", Musser, Samuel, and Anderson, Douglas, June 1995